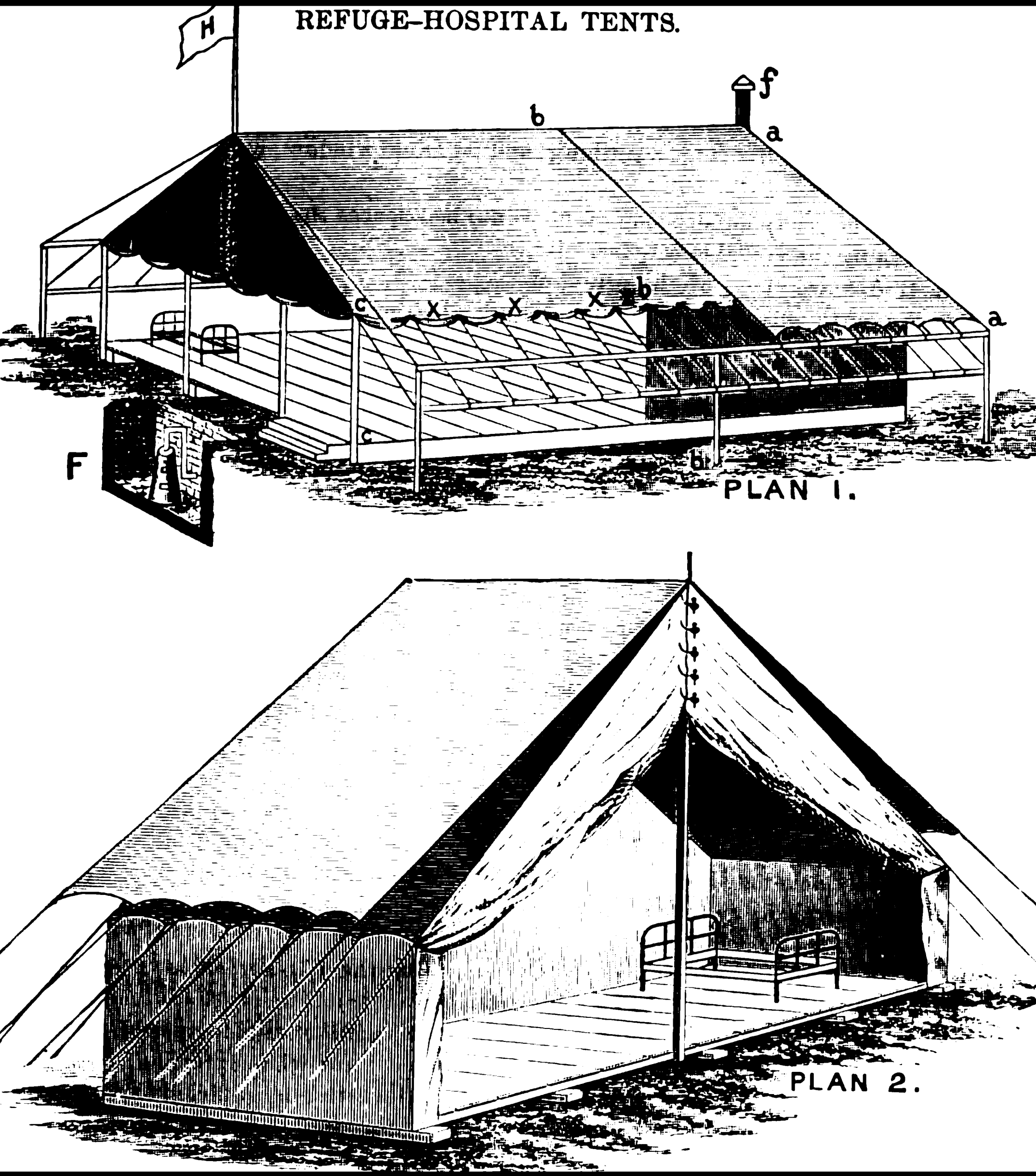


Annual report

New York (State). Dept. of Health, New York (State). Board of Health

To W. A. Post.
Dep'y. Attorney General,

SECOND ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

NEW YORK. (State) Dept. of health

TRANSMITTED TO THE GOVERNOR FEBRUARY 8, 1882.

ALBANY:
WEED, PARSONS AND COMPANY, PRINTERS.
1882.

STATE OF NEW YORK.

No. 9.

IN ASSEMBLY,

February 8, 1882.

SECOND ANNUAL REPORT

OF THE STATE BOARD OF HEALTH.

STATE OF NEW YORK,

EXECUTIVE CHAMBER,
ALBANY, *February* 8, 1882.

To the Legislature:

Herewith is transmitted the Second Annual Report of the State Board of Health, ending December, 1881.

ALONZO B. CORNELL.

[Assem. Doc. No. 9.]

THE STATE BOARD OF HEALTH OF NEW YORK.

MEMBERS AND OFFICERS OF THE BOARD.

State Commissioners of Health; appointed by the Governor and Senate.

HON. ERASTUS BROOKS, West New Brighton, Richmond Co.
J. SAVAGE DELAVAN, M. D., Albany.
ELISHA HARRIS, M. D., New York, P. O. address, Albany.

Appointed by the Governor, from the Health Commissioners in Cities.

EDWARD M. MOORE, M. D., Rochester.
PROF. CHARLES F. CHANDLER, Columbia College, New York.
JAMES G. HUNT. M. D., Utica.

Ex-Officio Members.

WM. M. SMITH, M. D., Health Officer of N. Y. Quarantine, S. Is'd.
JAMES T. GARDINER, Sup't of State Survey, Albany.
HON. LESLIE W. RUSSELL, Attorney-General, Albany.

OFFICERS OF THE BOARD.

President,

DR. EDWARD M. MOORE, Rochester.

Secretary,

DR. ELISHA HARRIS, Central Office of the Board, Albany.

State Superintendent of Registration of Vital Statistics,

DR. HARRIS, as Secretary of the Board.

CONTENTS.

State Board of Health of New York.

SECOND ANNUAL REPORT.

To Hon. ALONZO B. CORNELL, *Governor of New York:*

SIR — In the report submitted a year ago this Board presented outlines of the several branches of sanitary work it had organized during the first half year of its service. The report now presented will show what progress has been made in the work during the year ending December 1, 1881.

The first duties which the laws have imposed upon the State Board of Health require that in taking cognizance of the interests of health and life among the people of the State, it shall make inquiries in respect to the causes of disease, especially of epidemics, and investigate the sources of mortality. The obligations of the Board to obtain, preserve and use such information, and by all suitable means to aid the people in their local sanitary organization and duties, have become generally well understood throughout the State. The town and village authorities have been steadily organizing and perfecting the local health boards, and availing themselves of the provisions of recent laws, they freely seek whatever information and assistance the State Board can give. In this respect the constituted local authorities of towns and villages are evincing their worthiness of the trust which successive Legislatures repose in them. The organized townships and cities being the units of which the State is composed there is abundant reason for testing the willingness and ability of local sanitary authorities to perform the duties now required at their hands under the existing laws relating to the public health and vital registration. Without hesitation the State Board of Health has thus far endeavored to take all possible advantage of these laws in their obvious meaning, and of the best provisions of the local government organizations as found at the time available in the towns, cities and villages, for giving practical effect to these laws, so far as this Board may participate in or usefully influence the administration and execution of them.

In this report the action taken by the Board during the year, the information obtained by it, the vital statistics and the sanitary condition and prospects of the State will be concisely presented under the following heads; and for the purpose of completing the information which should herewith be submitted, classified statements and special

reports are hereto appended as a body of evidence in which the connected points of review and suggestions, as here submitted by the Board. will be fully sustained :

I. Prevalent Diseases.—Small-pox, Diphtheria, Scarlet Fever, Typhus and Typhoid Fevers.

II. Distribution and Local Government of the Population.— Local Boards of Health.

III. The New Sanitary Laws.— Chapters 407 and 431 of 1881.

IV. Reports of the Committees.

V. Investigation and Prevention of Stench Nuisances.

VI. Procedures under the eighth section of the State Board of Health Act.

VII. Laws and Sanitary Provisions relating to Small-pox and Vaccination.

VIII. Impure Water Supplies. Pollution of Wells and Streams.— Water Analysis.

IX. The General Drainage Laws.

X. Sanitary Drainage of Villages, and the Treatment of Drainage areas in populous districts.— Disposal of Domestic Waste Matters.

XI. Public obstructions to Natural Drainage. Sanitary questions connected with the Abandoned Canals, and the Malarial Grounds near the Erie canal.

XII. The extent of Preventable Causes of Malaria in the State.

XIII. Sanitary Inquiry relating to Prevalent Acute Diseases.

XIV. The State System of Registration of Births, Deaths and Marriages.

XV. Expert Services.

XVI. Health in the Schools.

XVII. Tenements.— Protection of Health and Life of Tenants.

I. Prevalent Diseases.

Healthful and prosperous as the past year has been in the State of New York, those acute contagions which are the enemies of child-life, have prevailed in a great many localities, and, as usual, have desolated thousands of homes. Scarlet fever, diphtheria, small-pox, the most conspicuous of these enemies, have not limited their prevalence to the crowded cities, and the poorer classes in villages; but they have been especially malignant and fatal in rural neighborhoods, and even in the remotest districts. As the year is now closing, diphtheria and small-pox are being reported as in progress in remote hill districts where sanitary safe-guards against such evils have been least thought of hitherto. The more we know of the places and habits of these contagious maladies the more conclusive is the evidence that whatever may

be the importance of local conditions that promote their propagation, the *contagia* or communicable poisons which they produce and spread abroad, must be controlled and "stamped out," as the very first sanitary duty by public health authorities.

The conditions under which contagious and other fatal diseases become localized are well understood, and the diseases themselves which depend upon these conditions for their persistency and greatest public harm are now justly termed filth diseases, foul-air diseases, and the endemic, epidemic and contagious kinds of disease.

Endemic and epidemic fevers, which have for ages had a written history, still prevail under conditions not unlike those that have found their record in ancient story and in the annals of the districts where marshes, neglect of drainage and sewerage, sodden grounds and predominating uncleanliness have propagated miasmatic and filth diseases.

The increasing prevalence of miasmatic diseases during the past few years in New York, and other States in our latitude, is receiving careful attention from this Board, and from some other State Boards of Health.

The frequent recurrence of small-pox in communities that were presumed to be as well protected as others against it; the outbreak of diphtheria in widely separated towns and villages; its fatal persistence in several of the cities through the last fifteen years, and its recurrence again and again in the same towns, in the same valleys, and upon the same hillsides, or in particular neighborhoods, where, within the last twenty years, it appeared for the first time in the present century, are supplying facts which seem to show either that the sanitary measures hitherto adopted were not in any sense adequate to the extermination of the causes of this disease, or that it prevails so capriciously that ordinary sanitary measures may not reach its causes.

The appearance of scarlet fever in every county in the State, and its varying but always terrible fatality and dreaded consequences, and the frequent prevalence of measles and whooping-cough which destroy a vast number of children's lives annually in the State, by the fatal effects they produce upon the respiratory organs ; these, when counted together, are found to be charged with a very large percentage of the total mortality, year by year. The diseases here enumerated are not altogether to be accredited to filth and foul air; they are contagious diseases, and spread by their own specific poisons. Hence, they will all admit of a certain degree of definite sanitary control; and as hygiene and medical philosophy, founded on exact experimentation and research, now teach, there may be no plainer or imperative sanitary duty imposed on health boards, physicians and householders than correctly to understand, and promptly to apply, the known resources of

hygiene to the control and extinction of the contagious elements upon which these harmful diseases so largely depend. As regards small-pox, diphtheria, scarlet fever, and the typhus and typhoid fevers, these are plain sanitary duties; and in this report we summarize them under the heads: (1.) Isolation and Quarantine. (2.) Cleansing, Disinfection and Extinction. The reports of the standing committees on Vital Statistics and on Quarantine present certain public aspects and results of these duties.

This Board has thus far rarely had difficulty in its efforts to induce local boards of health to make it an invariable duty to enforce all needed obligations for the domestic or local quarantine, disinfection and cleansing which are adapted to and necessary for protection against each of the contagious diseases.

The amended general law prescribing the organization and powers of local boards of health (chapter 431 of 1881), confers on every local board adequate authority, and prescribes the necessary safeguards, for the exercise of such powers, for the suppression and extermination of sources of contagion. The circulars of information prepared and issued by this Board, supplying to all health officers and boards of health having need of sanitary information and advice in regard to the acute kinds of contagious diseases, and the treatment of infected persons, places and things, have been sought after and made practically available in the warfare against these enemies of households and communities. The first issued relates to diphtheria, and, though designed for communities that were in great alarm and peril, remote from physicians, and without the jurisdiction of any local board of health, has become the most useful and necessary of all in this list of circulars of information and advice. This, as well as the others — six in number — will be found hereto appended.

Essential facts relating to these diseases.— Important progress is being made in the knowledge of causation of the destructive contagious and infectious maladies. The wonderful disclosures in inoculation, as practiced in the time of Lady Wortley Montague, and by vaccination, the great discovery of Jenner, seem to have been but preludes to the discovery of certain fundamental facts relating to the means by which diseases most fatal and obstinate are rendered controllable. In respect to this matter, however, we may reasonably believe that sanitary and medical science is only upon the verge of great discoveries and definite rules of sanitary practice by which the human family shall be adequately guarded against the most destructive maladies. The National Board of Health is attempting to subordinate to the demands of sanitary science numerous expert investigators who already report conclusively practical results concerning the causes and spread of diphtheria.

Small-pox.— This disease, which marks its victim for life, is at last so well understood as an unmasked destroyer that its contagion is readily controlled and extinguished by definite rules of disinfection, and by enforcing the absolute isolation or quarantine which the local and State sanitary codes now require; vaccination, at the same time, presenting the boon of protection with as much claim to efficiency as it ever had. In special reports appended will be found practical illustrations of these subjects which all people should understand. It is for this reason they are introduced as a body of evidence. Small-pox continues to be a curse and a terror to the communities in which it appears, where neither vaccination nor adequate sanitary regulations are already in the line of defense against it. Perhaps nothing has occurred in the history of small-pox that is more instructive than the protection which the towns of Kingsbury, Fort Edward, Argyle and Caldwell obtained by means of sanitary organization, domestic and local quarantine, and, chiefly, by the complete defense which vaccination and revaccination secured. As the reports show, the Board of Health in the village of Sandy Hill (in the town of Kingsbury) called for, and gratuitously used, 1,250 vaccinal points, immediately upon notice of danger, in time to confront the peril from the nearest neighboring village — only three or four miles away — while the next contiguous and populous towns and villages secured immunity by the same means. The five towns which were most exposed to the contagion, that was rife in the populous village in their midst, as is shown by the reports, secured their immunity by promptly applying vaccination to several thousand persons, at a cost which is but a small fraction of the sum that was expended by the single rural town of Salem, in December and January last, in the attempt to control an outbreak of small-pox in the little hamlet of Shushan. The total cost of "stamping out" small-pox that was stealthily introduced into the town of Queensbury, and its chief village, Glens Falls, amounts to nearly $8,000, while the entire expenditures upon the thorough vaccination and revaccination that protected the towns of Fort Edward and Kingsbury, and the village of Sandy Hill, amounted to but a few hundred dollars. The total and detailed results of vaccination, as studied by the officers of this Board, and now attested in every locality where this protective agency has been seasonably resorted to, seem to confirm all that Jenner and all enlightened physicians, from his day till now, have claimed for the place which vaccination holds in well regulated public health service.

Pure and trustworthy virus. — This Board directed three of its standing committees, as shown in the appended abstract of proceedings, to prepare a report upon suitable State supervision and sup-

plies of necessary vaccinal virus from inoculated calves; in other words, upon the subject of a "bovine or vaccine farm." Such a report will be expected from those committees early in the winter. It is deemed of the utmost importance that there should be the most trustworthy and ample supply, and the best methods of distributing it to local health officers, and for the gratuitous offering of it to the needy in the community, under suitable sanction. Precisely these duties are what is implied by this Board's action on the subject. It is simply renewing the memorable methods of the discoverer of vaccination in the careful culture and preservation of the full virtues of the vaccinal virus. Therefore, we respectfully commend the subject to your attention and to that of the legislature. A "bovine or vaccinal farm" consists of an organized arrangement for skillful selection, keeping and inoculation of heifers, the vaccinal vesicles upon the tender skin of their loins, being produced, at a great number of inoculated places, precisely as in the arm of an infant. Fortunately, there are several private establishments of this kind in the United States, but there is none in New York. The State of Maryland has, for several years past, maintained such an institution, and paid the expense for supplying pure virus gratuitously to all who will accept it in the State. The cost is not great, but the skill and precision required in the service should be perfect.

The Board mentions, with much satisfaction, that out of the several thousand supplies (points), of vaccinal virus for which it temporarily guaranteed the payment, wherever purchased (for bovine virus has been obtained at great disadvantage from several States to meet urgent demands) only a few dollars worth has, thus far, been required to be paid for from its funds. The largest amount so guaranteed for any one health board was for 1,250 points in a single town. The fact that health boards of towns and villages have no available funds of their own, but must await an auditing at some distant time, has rendered this mode of assistance to them quite important in the effort to afford general public protection against small-pox.

Diphtheria. — It is now twenty-three years since diphtheria appeared in a malignant form in the city of Albany and desolated an extensive district south of State street, in the old quarter of the city. It raged fatally for several months in that district, and had nearly disappeared before it was announced as prevailing elsewhere in the State. More than sixty years had then elapsed since it had prevailed in any part of the State, and then it was under the name of malignant sore throat, etc.; and it appears to have been perfectly described by the physicians of that period. Now it is known by the name given it in France in later times, Diphtheria; but, as a terrible domestic pestilence, no

name has yet defined its fatal *nature*. It was prevailing in various places when this board began to organize its duties in the summer of 1880. It had destroyed upward of 15,500 lives in the city of New York alone during the preceding twenty years, and in the years 1874 and 1875, 3,994 deaths were charged to this single cause. In the State of New York there had been destroyed in these last two decades a number terrible to contemplate, — upwards of 70,000, it is estimated, — and these were largely among the most promising and valued child-lives wherever the disease prevailed; for it is not more the pestilence of the poor than of the affluent.

In the report which this Board presented a year ago it is shown that diphtheria has prevailed in remote and even wilderness regions, among people sequestered from ordinary intercourse with populous districts; that the malady presented its malignant characteristics; and that, by whatever general conditions it may have been spread, there was absolute proof of its propagation from person to person, and from house to house, over long distances, by individual carriers of its propagating cause, though not themselves sick with it. In other words, diphtheria is a contagious disease, whatever may be the endemic and epidemic conditions which favor its propagation.

Though it is not for this Board to discuss medical questions in its report, it is important that the most essential truths relating to these and other contagious maladies should be unhesitatingly exhibited in the Board's policy and acts, and this may as well be stated here as anywhere in regard to this subject. The isolating or quarantining of the sick and the carriers of these contagious pests, and their virus, by disinfection and cleansing of all places and things that propagate or convey the contagious poison, are plain duties which should be enforced by every local board of health and by every physician and householder.

Diphtheria has continued to appear in widely separated districts, and in the most secluded as well as in the densest populations of the State. Perhaps there has been nothing in its history the past many years more distressing than its recent prevalence in certain districts of the upper Hudson, in Warren and Essex counties, remote from physicians, where the families of the hardy people have usually enjoyed an immunity from destructive diseases. Some details respecting this experience are appended in reports now submitted.

Scarlet fever.— This disease is probably more widespread and continuous in its presence than diphtheria, and possibly destroys more lives. It is perhaps less amenable to sanitary measures, which boards of health may control, than diphtheria. Like the latter disease it is the bane of crowded schools, and is a dreaded pest. Not only is its con-

tagious progress not easy to prevent by ordinary ventilation and the lapse of time, but it engenders secondary results so pernicious, and so often fatal, that it should be regarded as an enemy to be kept out of the dwelling, the family, the school and the community. The once popular idea that it is best to take the risk and "let the children have scarlet fever," should be no longer accepted. *It is best not to have it.* Its contagion, at least, should be kept far away from every habitation, school, vehicle and public assembly. The remains and funerals of its dead should expose no one to its contagion. In this respect the same rule should apply as in the case of the remains of the dead from small-pox and diphtheria.

Typhus fever.—Nearly a year ago, typhus, contagious and insidious in its march, was found to be prevailing among tramps. Officers of the State Board of Health of New Jersey discovered the disease at Camden and elsewhere, near Philadelphia, late in the autumn of 1880. It was soon found domiciled in a great company of wretched vagrants, in the "Tramps' Lodging House," near Broadway, on Prince street, New York. In a few weeks it was found to be spreading in several blocks of tenements; but having aroused the ever alert medical officers of New York City Board of Health, this threatened contagion was reported as extinguished before the first of July.

A brief account of it is given in an appended report. There is every reason to believe that this contagion did not gain a foothold through any failure of the New York quarantine establishment. The first cases in the State, and the connections of those cases are traced to another source.

Typhoid or enteric fever.—This type of filth-diseases has appeared in numerous places; yet has not, in most instances, had a deadly prevalence. It has come to be one of the diseases with which the common sense of the people grapples successfully wherever they consult and implicitly follow competent sanitary officers and enlightened physicians. Foul outflowing, neglected privies and excremental filth, polluted water, and even the daily milk supplied to families (when defiled by water which has received any of the infectious matter of enteric fever) now command attention wherever a first case of the malady is discovered. Variable in its degree of malignancy, and thus readily associated with other diseases and causes of disease, there seems to have been the greatest suffering and fatality from typhoid fever in regions where malaria is also present. Hence the very frequent communication of information to officers of this Board of outbreaks and fatal cases of what physicians recognize and frequently denominate as typho-malarial fever.

In order to obtain trustworthy information in regard to the extent

of localities and local conditions under which the prevalence of true malarial diseases has occurred during the past year, the Board directed its committee on Vital Statistics to make suitable inquiries by means of a circular addressed to physicians throughout the State. That inquiry is still in progress and promises important results. The committee that has it in charge reports, in a statement hereto appended, many instructive and interesting facts. This investigation of fevers and malaria will continue through the coming year. We make reference to it because of important relations to, and discriminations between, the deadly filth-disease known as the enteric or typhoid fever, and the disabling but less fatal fever-and-ague or malarial fever.

The committee's report shows that there is abundant evidence that malaria, so called, that is, the poison which produces periodical fever and various miasmatic maladies that are attributed to that paludal poison, has, in a recent period, made a wide departure from what were supposed to be the limits of its prevalence; and appears now to have extended further beyond the swamps and lowlands than in former years; yet it is so associated with swampy grounds and stagnant pools and with the foul margins of drying streams and ponds, that there appears to be no good reason yet for depreciating the correctness and importance of the common opinion that the conditions here mentioned are essentially concerned in the propagation of malarial disease. It is as necessary as it is easy to identify and fix the responsibility for the causes of filth-fevers, known as enteric or typhoid. It will be advantageous to the public health, and important to sanitary authority, if in the identification and hygienic management of endemic and epidemic diseases and their causes, all of their contagious and infectious attributes shall be brought under as definite control as their localizing and external contributing factors should be.

Other prevalent diseases.— The diarrhœal diseases of children as they have prevailed in certain limited localities during the past season, and fatal miasmatic diseases, have received such attention from this Board, and from local boards with which it has communication, as has been required. The most important outbreak of enteric disease to which this Board's attention has been called occurred late in the season at a tomato-canning establishment in the town of Southfield, Staten Island; and, as many of the sufferers were recent immigrants, the Commissioners of Emigration invited the attention of the health authorities to them and to the important evidence of the personal neglect and the sanitary wants of the sufferers.

A full account of the facts is briefly given in the report now submitted by the committee on vital statistics. Dr. Carroll, an expert sanitary inspector, under instructions from this Board, has shown quite

clearly that both typhoid fever and dysentery prevailed upon the premises complained of, and that as regards the fever, it was introduced from abroad, and spread by its own infection under the favoring miasmatic conditions which prevailed upon the premises where some two hundred persons were employed. These workmen were lodged in crowded bunks at night, and seemed to have been utterly negligent and filthy in their personal habits. Dr. Carroll reports that the prevailing fever was of a miasmatic and adynamic type, and that it must be regarded as essentially a localized epidemic in a malarial spot.

House epidemics and other strictly localized outbreaks of fatal disease affecting the bowels, or otherwise seriously harming a great number within a limited area, have occurred in numerous places. At various points along the Erie canal, in the immediate presence of nonused or partially filled basins and obstructed water courses, where filthy outflowing of villages or of a few dwellings had intensified the miasmatic nuisances, the most striking illustrations of such local suffering have occurred. One of the most extensive areas that has been invaded by endemic bowel diseases, and far the largest population that has thus far suffered in any one locality in this State, we find described in the reports received from the city of Buffalo, where within geographical limitations that require further investigation, great numbers of lives were lost by diseases known to be preventable, and which, as reported, appear to have been caused chiefly by the needless faults in domestic water supplies. This subject is still under investigation, and some important evidence relating to it will be found in one of the reports hereto appended.

Distribution and Local Sanitary Government of the Population.

The tenth national census found 5,082,982 inhabitants in this State, and of these there were 2,506,959 living in the twenty-four cities; 1,803,254 were found in the four cities of the metropolitan district, namely, in the city of New York, 1,206,577; in Brooklyn, 560,698; in Yonkers, 18,892, and in Long Island City, 17,096. The chief city of the western border, Buffalo, contained 155,137, while in Albany, Troy and Cohoes, at the middle of the eastern border of the State, were found 167,067 inhabitants. The cities which are thus becoming greater are the first fields in which the care of public health presents the questions that have received more attention from the Legislature than has been given to the general promotion of sanitary protection. The city boards of health bear little resemblance to each other. They are as diverse as the caprice of the endless amendments of municipal charters can make them; yet New York, Brooklyn, Yonkers and Buffalo pre-

sented such reasonable claims to fitness of their respective modes of organization of municipal public health service that the last Legislature excepted them from the operation of that provision of the amendment of the general law for local boards of health, which defines the membership of a board.

The other cities in the State can avail themselves of that special provision and of all the powers which the Law of 1881 (chapter 431) confers. The Legislature thus opened the way, at least, for these twenty cities to improve and simplify their public health service.

The three hundred and twenty-six incorporated villages in the State are yet so identified with the interests and much of the responsibility of the local government of the townships in which they are situated, that only a portion of them have organized separate boards of health. So far as we know the results of the administration of town boards of health over the sanitary affairs of the smaller villages is satisfactory, wherever the town and village authorities have agreed so to treat the public health and registry duties. There are a few instances in which the village area is conterminous with that of the town; and there are numerous others in which two or three more towns are in part comprised in an incorporated village. In the latter instances the maintenance of the village organization for certain branches of the local government, and for those of the public health and registry especially, is very important. Wherever the proper sanitary preparation of a village site, the adoption of drainage and sewerage works, the introduction of a public water-supply, and the maintenance of systematic sanitary inspection are provided for in a village, the necessity for its own separate board of health is obvious. The amended law, before mentioned, has made special provision for the separateness of village and town accounts in respect of all expenses of sanitary works and official services that should be chargeable only to the incorporated village, on the one hand, or to the township on the other. In numerous instances the duties in which the State Board gave its aid and advice for the repression of diphtheria, small-pox and certain causes of danger in villages, the corporate limits of the village extend into several contiguous towns, so that whatever is effectively done must be at the cost and by the authority of the corporation and under direction of the village board of health. On the other hand there are recent instances of necessity for the prompt joint action and mutual agreement of the town with the village authorities, as witnessed in the town of Queensbury and its contained village of Glens Falls, where the suppression of small-pox could not be effected without such co-ordinate action, as numerous families along the corporate limits and beyond them were already smitten with the contagion, the danger was common to all, and

the lazarets for the sick had to be located in a sequestered field, a mile or two beyond the village. The seventh section of the amended general health law has proved entirely satisfactory in these varied exigencies.

Towns.— In each of the 947 townships of the State the amended law provides that there shall be a board of health constantly maintained. The distribution of upwards of 2,000,000 of inhabitants in these towns may vary even more widely than at present; and yet the necessity for having all suitable records kept, all facilities of official communication at hand, and all the means of protecting health and life as freely afforded to the inhabitants of remote towns, as to those which are near, when the State offers advice and assistance, is obvious. The laws now provide for and require this. The fact appears again and again, in the body of evidence herewith submitted in the appended reports, that remote, sparsely populated, and the least affluent communities in the State have frequently needed and sought the aid of this Board and that they have promptly and effectively organized and begun their town board of health duties. The 11,400 common school districts in the townships have served as the ultimate units of the civil organization in our State, and under the provisions of the Laws of 1880, this Board has derived great advantages from the privilege of communicating directly with the school district officers who are ever informed and cognizant of the events which need to be made known alike to this Board and to the town authorities. The ultimate extension of sanitary observation to and within the school districts and the remotest habitations in the commonwealth, the inducing of a responsible concern for human life and health and the registry of the three signal epochs of life in every family, and, if possible, to so exercise the authority and influence which the laws have entrusted to this Board, that the families, neighborhoods, towns, villages and cities in New York shall carefully do their respective parts in guarding against preventable harm to health and life, is the supreme endeavor of this new department of State service.

This distribution of the civil organizations and distinct kinds of local government of the population in the State will ever preclude the operation of a centralized assumption of the details of execution of sanitary laws and regulations; for, upward of twelve hundred local government organizations, namely, the towns and villages, are to be ever held responsible for the public health and the vital registry within their jurisdiction, respectively. The State Board is beginning to find it practicable to co-ordinate and connect all these into a State system.

Local Boards of Health.

At the time when the Board was organized in the summer of 1880, the twenty-four cities, and perhaps twenty of the townships and twice as many of the villages, had some form of sanitary government. The general public health law of 1850, which had been called into existence by the terrible events of cholera in the previous year, was everywhere available as a basis for correct sanitary organization to meet such exigencies as the introduction of cholera and other pestilential diseases might render necessary in the incorporated villages (the number of which is steadily increasing, having only in a few instances availed themselves of the general provision made in the law for the organization of villages in 1870; and some of the older villages, incorporated under special charters, had for a board of health, whenever it might please the village trustees, the board of trustees itself. Few, if any, of the local boards in villages or in towns evinced any activity, or had any special preference for a particular method of sanitary organization. In cities and villages alike, with rare exceptions, the chief health officers held their places rather as a matter of favor than of fitness. New York, Brooklyn, Rochester, Buffalo, Elmira, Poughkeepsie, Newburgh and Yonkers were, in some worthy degree, exceptions to this general condition. It was early ascertained that in all parts of the State the more enlightened and public-spirited citizens expressed a desire for decided improvement in this sanitary service of the people, in townships as well as in villages.

The amendment of the general public health law of 1850, and all subsequent acts amendatory of it, were so obviously necessary that the last Legislature enacted a certain amendment which is known as chapter 431 (Laws of 1881). Though that amendment may not prove to be entirely adequate to meet all requirements in the interests of public health — it certainly has produced excellent results thus far. Its chief advantage consists in enabling a town, village or city to organize its board of health upon a basis of competency and power to become efficient, and yet to be required to maintain a strict accountability and economy in all its affairs. It provides that the State Board of Health shall call into organized activity any town board of health, and that such board must maintain the laws relating to the complete and perfect registration of deaths, births and marriages, and also be ever in readiness to repress and provide for contagious and infectious diseases and other causes of danger to the public health.

It is believed that the amended law will work no hardship to any one, and that it has already proved more economical and directly effective in its operation, by far, than the provisions of law which it amended.

The township, the city and the incorporated village have from the beginning of the State's history constituted the units of local government, and they are endowed with a large authority to do those things which are necessary for the special welfare of the community. The traditional and historical importance of these primary civil divisions and local governments seem to make it quite suitable to trust largely to them in the administration of public health laws. Numerous statutes relating to public health, all alike recognize the obligation of the town, village and city to provide well for the protection of life and health, and also for the registration of the vital records within their respective local jurisdictions. Yet in making the law of 1847 (chapter 152) and the law of 1880 (chapter 512), relating to registration, there is such recognition of the competency and duty of county boards of supervisors to provide, or to regulate the rate of compensation, etc., for this registry service, that it has become a delicate yet very necessary duty to modify the operation of these two statutes to such an extent as to make each local board of health responsible for the completeness and efficiency of this duty relating to the vital registry, which, as now construed in all counties, is closely allied to the necessary sources of information and duty of local sanitary authorities. Under chapter 431 of 1881, this part of the duty of local boards of health has begun to be provided for, but whether this law supplies all the ways and means that are necessary for securing perfect results remains to be seen. Thus far it works well, and certainly works no hardship, though it imposes onerous duties on some of the boards of health.

Town boards of health.— The town board, as organized under chapter 431, proves to be, thus far, without any exception known to us, working economically and successfully. Nothing, perhaps, can exceed the simplicity, and probable certainty of harmonious and effective organizing and maintenance of the duties of the town board of health. A description of what occurs on a call from the State Board of Health to the supervisor of the town to organize the local board of health is detailed in a few words:

First. The supervisor, at the request of the State Board of Health, or of his own motion, or that of other citizens, convenes the justices of the peace and the town clerk; they at once proceed to elect a member, especially to counsel and aid in their work. These together constitute the town board of health. They must elect a competent physician to be health officer.

Second. The regulations and orders which the board would promulgate are duly adopted and published or publicly posted.

Third. The board, by regulations and rules which it adopts, is required by law to make the registry of deaths, births and marriages

complete and perfect, and to adopt and maintain such regulations as are necessary for the proper sanitary care, removal and burial of the dead.

Fourth. The board is required to promptly recognize the presence of, and provide for, the isolation and sanitary control of small-pox, diphtheria and other contagious pests; and in doing this to report to the State Board of Health, and to seek whatever counsel and information may be needed to meet emergencies. In the report of one of the standing committees here appended, a few illustrations appear in connection with current statements of procedures for the suppression of dangers to public health in remote townships.

It is believed that in every one of the nine hundred and forty-seven townships the local board of health provided by law should be organized and kept in a condition of constant efficiency, and that no county board of supervisors should delay to authorize the few needed provisions for maintaining the duties which relate to the registration which the law now directs every town board of health to supervise and make complete.

Village boards of health.— Each incorporated village in the State may claim its right to organize and maintain its separate board of health. Many such boards have been already organized within the last six months, and in some instances the village is by mutual agreement, or under the supreme necessity of the occasion, united with the town board in most important duties of their respective jurisdictions. A conspicuous illustration of this is presented in the history of action taken in suppressing small-pox at Queensbury and Glens Falls. Attention is invited to this instance which is fully narrated in an appended report. The town board of health thus accepting and promptly meeting imperative responsibilities in the presence of spreading pestilence, as in Queensbury, proves the value of the traditional duty and powers of the town to guard its entire population when all are in danger, and to stand in the breach for the welfare of the commonwealth. Perhaps no better example than that given in the town of Queensbury has ever been witnessed. Its chief village was infected in numerous streets, and the country endangered far and wide. The town board of health organized, made the village health officer its own, constructed and outfitted hospital huts in a night, and assumed the cost.

Village boards of health find before them at the very first of their service, under whatever law they may be created, that certain most essential duties demand their attention. The chief of these relate to adequate sanitary preparation and improvement of the village site by systematic drainage, the adoption of suitable methods for the disposal of excremental and other outflowings and waste matters, especially as

regards house-drainage and the common sewerage, the provision and protection of pure water supplies and the regulation of such sources of nuisance as the laws enable the village boards of health to contro or prevent.

It so often occurs that the village site is, from the first, insalubrious and topographically unfavorable, as respects drainage, or by an environment of swamps, ponds and neglected grounds and by the pollution of the common water-supplies, that some general sanitary improvements have to be ordered by the village government. Not unfrequently are these sanitary requirements of such a nature that it is necessary to seek to extend the drainage works and other improvements to a considerable distance beyond the corporate limits. In one instance which was early brought to the attention of the State Board, nearly one-third of all the inhabitants of a large incorporated village was found suffering from a malarial fever which was ascertained to arise from stagnant pools and sodden grounds a little distance beyond the corporate village limits.

The general provision for investigation and action under orders by the Governor as defined by sections 8, 10 and 11 of the organic law of this Board appears to be quite necessary wherever demanded for such cases. In certain instances of such investigation by order of the Governor, the evils complained of have been in two and even three or four contiguous towns, at and near the central village, and, in some instances, the complaints and requirements for sanitary action extended into adjacent counties.

City boards of health.— With scarcely an exception, the city charters and their successive amendments have devised various modifications for the organization and working of the municipal board of health. The general health law of 1850, having provided that the mayor and common council may and do constitute the board of health, that law became the common basis of most of the city health boards; but it was early found, and has been often illustrated, that the identity of the municipal legislative board with its health board, offers not only temptation and facilities for mal-administration, and costs which are wrong; but that expertness and efficiency in the sanitary service are rarely obtained under such circumstances. It was for this reason that the Legislature in 1881 provided that it should be the duty of the common council of every city in the State (except in a few instances), to appoint a board of health to consist of six persons who are not members of said council, and that the mayor shall be a member *ex officio* and also be president of the board. Of the six members so appointed (and "one of whom shall be a competent physician") two are appointed annually after the first board is filled. Whatever may be

the action of any one of the cities which may need to improve the sanitary service, the law here mentioned is sufficiently good and practicable to be worthy of adoption.

As upwards of half of the entire population of the State dwells in the cities, and is necessarily exposed to the innumerable causes of diseases which breed in filth and foul air, and especially to infectious fevers which are ever present in the larger of these cities, if not in all of them, it is a matter of the utmost importance, not only to the cities themselves, but to the entire State, that the best possible care of health and life should be provided for in every city. The terrible neglect and waste of health and of human life in the metropolis of the State, became a historical fact, and so aroused the concern of the people in all parts of the State, that the Legislature, in 1866, enacted that remarkable law which has become the basis of one of the best sanitary codes in the world; we refer to the Metropolitan Health Act, and the code that is based upon it. The question now is, how shall every city in the State secure as good, or even better, sanitary government? The State Board of Health feels in duty bound to advise that wherever it is practicable, under existing charters in this State, the local boards of health shall be organized in accordance with the provisions of section 1 of chapter 431, Laws of 1881.

The New Sanitary Laws, Chapters 407 and 431 of 1881.

Chapter 431 of the Laws of 1881, designed to facilitate and strengthen the service of local boards of health has been referred to in the preceding pages, with examples of its operations. More examples of the same kind will be mentioned in the appended reports. If this law need still further amendment it will be with reference to clearer definitions of health officers, the simplification and better arrangement of the general laws with which it stands related; and, probably, with reference to a carefully guarded power to be conferred alike upon the State Board and all local boards to give effect to the obligatory duties of professional persons and householders to furnish the certified records required for the registry of vital statistics. The outline of a brief amendatory act will be submitted to the Legislature for the attainment of these most important objects.

Chapter 407 of the last session laws has laid upon this Board the duty of conducting all investigations required by its provisions for preventing the adulteration of food and drugs.

The law defines adulteration and declares it to be a misdemeanor. It provides for a system of inquiry by inspection, examinations and analysis of all articles used as food or medicine under such rules as the Board prescribes. The results of the investigations thus far made have

demonstrated the necessity of this act. It is fully approved by the Board, and no delay has been made in organizing the bureau of chemical analysis of food and drugs as the Legislature directed. Eight chemists and three inspectors were thus assigned to their respective tasks under definite instructions, within specified limits and rules that enable each one of the whole number thus employed to go on with his work without encroachment upon any of the others.

The report of the standing committee to which this branch of duty was committed presents a series of papers in a separate report. The object of the initiatory investigations was to ascertain the nature and extent of the various adulterations found in articles sold within the State, and to determine the best methods for detecting them under the law; also to secure the necessary data by which to fix the standards of purity. An elaborate report of this work is hereto appended.

Reports of Committees.

The executive and finance committee reports that the total expenditures of the Board during the fiscal year ending September 30 amounted to $10,305.51, and that the total during the entire history of the Board, sixteen months to that date, was $13,906.08. There was at that date a balance in the State treasury to the credit of the Board from the first appropriation of $1,093.92, or more than sufficient to meet all accounts then due.

Estimates for all anticipated requirements of the Board for the year beginning October 1, 1882, have been approved and sent to the Comptroller.

The sanitary committee's work comprises the separate papers relating to the work under the food and drug law; also a special report upon water analysis and the sources of defilement of drinking water, and an extended report of original investigation upon methods and apparatus for a safety test to prevent dangers from illuminating oils.

The committee on registration and vital statistics presents its report relating to registration, together with a series of local reports on prevalent diseases.

The committee on sanitary legislation has reported upon State and national laws for preventing the spread of contagious diseases by immigrants, and upon rules and regulations of local boards of health.

The committee on quarantine has reported on the experience and results of the New York State quarantine establishment.

The committee on public institutions submits an important report on the results thus far attained in the sanitary inspection of schoolhouses. This report is supplemented by a special report by Dr. Lincoln, an expert engaged in this branch of the Board's work.

The committee on Drainage, Sewerage and Topography submits a series of statements showing certain plans and results of work under its supervision and advice during the year. This report is supplemented by two special reports by an expert engineer and topographer, who has been engaged, from time to time, upon the sanitary problems of the abandoned canals and of the great swamp areas of the Tonawanda and the Oak Orchard Creek basins. The chairman of the committee has presented an important statement concerning the drainage and the disposal of excremental and other waste matters in villages and populous towns of England.

Stench Nuisances.

The petition of many citizens of the metropolis, indorsed by the Governor's instructions to this Board, in January, 1881, led to a more protracted and difficult investigation and entailed greater tasks than had before been undertaken, and as the entire proceedings have been based upon the correctness and justice of the claim made by the inhabitants of the central and most elevated wards in the city of New York, to the effect that the people are entitled to the protection of the common atmosphere against the defilement of it by stenches and nauseous or irritating vapors and gases, this cardinal doctrine of sanitary protection was, from first to last, so important and far reaching that no temporizing, compromise or postponement could be justified in conducting this investigation and applying its logical results. The report and papers now submitted by the special committee to whom this matter was referred for investigation, etc., show that while the evils they confronted have been found amenable to sanitary treatment or removal, the principle involved in thus organizing a deliberate warfare against them will prove so comprehensive in its operation that other cities than our metropolis, and even any city or place of popular resort, may claim protection as justly as the affluent residents of Murray Hill and the dense population of tenements of the East river-side regions opposite and in close proximity to Hunter's Point and Newtown creek.

The details of experience in the Board's dealing with the stench-nuisance problems, as presented in various places the past season, need not here be given ; suffice it to say that precisely the same advice and the same kind of exact information have proved effectual as well as equitable in dealing with offensive effluvia from stench-producing trades and materials in populous villages and near great summer resorts. The committee reported that "not less than nine-tenths of all effluvium nuisances and matters of complaint by those who have given testimony on the subject, and as far as witnessed and investigated by

this committee, can be wholly controlled and prevented by simple and entirely practicable means, the working of which the committee has carefully examined and proved to be now in operation." And this Board has adopted the conclusion "that whatever means and regulations have thus, or shall otherwise have, been found to be good and sufficient, should be made a matter of obligation and necessity; likewise, whatever cannot be sufficiently controlled by available means for the prevention of such nuisances within the cities, or other immediate populous neighborhoods, should be removed to a reasonable and proper distance from the populous districts, and whenever any of these establishments are found they should, as a matter of course, be under suitable sanitary and police regulations established by local or general laws."

Whether enacted as a law, or left to the ultimate conclusion and recommendations of this Board and the executive orders and instructions thereupon, the plain principles and procedures here mentioned can be judiciously applied without hardship to any legitimate business that would be brought under such direction. State interference is not to be invoked in any such affairs until local authority hesitates, fails, or is found to be unsuited to grapple with the evils complained of. The Board finds that its conclusions and its advice in regard to the effluvium nuisances as subjects of sanitary interference are quite in accord with the conclusions which the expert commission under the Local Government Board of England has submitted to that board after years of skillful inspection and research.

Procedures under the Eighth Section of the State Board of Health Act.

Of the several cases which the Governor has referred to this Board, requiring it "to examine into nuisances or questions affecting the security of life and health," only the miasmatic nuisance connected with certain portions of the late Genesee Valley canal—now the property of a railway corporation — and the stench nuisances at Hunter's Point and upon Newtown creek have, during the present year, proved so general in their relations to numerous communities at once; and so unmanageable as regards any one board of health, that the executive interference, as defined in this section, has proved to be necessary. The reports of the special committee on the stench nuisances in the vicinity of Hunter's Point, and the papers relating to the abandoned canal nuisances, as herewith submitted, will be examined with interest by all who are concerned in overcoming great nuisances that extend their pernicious effects far beyond the local jurisdiction of any one board of health.

The nature of the evidence on which the conclusions of this Board were based, the mode of applying and enforcing the executive orders, and the spirit and methods of compliance in the instances here mentioned, may be regarded as marking the introduction and acceptance of an equitable and comprehensive policy in procuring the abatement and permanent prevention of great evils that are not amenable to local authorities within their limited jurisdiction. In the sanitary care of the abandoned canal prism between Scottsville and West Sparta a railway corporation is the responsible holder of the property, while parts of five or six towns and of two counties are suffering from the artificial swamps and stagnant pools of the abandoned canal-bottom. By accepting the order and instructions from the Governor, to execute the drainage works recommended by the State Board of Health, the corporate holders of the property thus prevent the delays and costs of local litigation, while the people of that region secure all the protection the State can offer. The last Legislature recognized the duty of responding to the Executive recommendation for removing the miasmatic nuisances that were complained of along various sections of the abandoned canals not yet released to estate owners. The same principle has governed in these two cases respectively. The Governor requested the State to abate the dangerous nuisances which menaced the health of a great number of families that were helpless in their exposure to the miasmatic bottom or prism of the canal, which had become a system of artificial swamps.

In the procedure, under Executive instructions to ascertain the sources and nature of the stench nuisances in the Hunter's Point and Newtown Creek regions, the extent and complexity of the causes, the great number of persons and corporate bodies responsibly concerned in them, and the necessity for obvious impartiality in the orders and action for suppressing and preventing the evils discovered and reported, the Governor's preliminary notice or proclamation, as issued April 22d, seems to have been well adapted to its object. The enormous assemblage of stench-producing businesses, offensive trades and trades offensively conducted, yet most of them truly legitimate industries, to be thus brought under sanitary control, or to be closed and suppressed for the sake of the vast population which complained, has imposed a task requiring much prudence, patience and careful investigation.

The report of the Special Committee to whom this task was committed by the Board shows that the eighth section of chapter 322, of 1880, is producing more comprehensive results than were at first anticipated. It is now apparent that it is possible so to apply and give

effect to this section of the law that the persons, corporations and invested capital which are responsible for evils which many share in causing, and which thousands of people share in suffering, shall become enlisted in controlling and suppressing them. The twelve petroleum refining corporations, while daily refining upward of 1,200,000 gallons and producing in that process upward of forty-five tons of sludge or spent-acid, adopted the necessary means for controlling and preventing all their causes of nuisance, and in their written guaranty they "do promise and agree that hereafter the said refiners and each of them will prevent the open exposure of spent-acid, the product of refineries, at any place within fifteen miles of any city in the State of New York during the warm season, and eight miles from any such city during the cold season; and that neither said spent acid nor any other offensive material, shall be permitted to flow, leak or waste into or upon the ground or streams, * * * and that whatever * * * shall be used at or by said refineries as fuel shall be so perfectly consumed that thereby no hurtful or offensive smoke or stenches shall be produced. * * * " This engagement has been adhered to with the utmost fidelity. The Board places this testimony on record to illustrate a method of enlisting the best resources of great industries in procuring compliance with sanitary laws and regulations.

The director of the most extensive of the superphosphate fertilizer factories, whose premises in Queens county were near the Murray Hill district of New York, wrote, after receiving the Governor's orders, "we concur entirely with your committee, that 'whatever cannot be controlled by available means should be removed to a reasonable and proper distance from the populous district.'" The adoption of this view of public and personal duty, as regards widely spread stench nuisances, has at last procured the removal of not only the worst source of effluvium nuisance that failed to be controlled, but it has come to be accepted as a correct basis for law to repress and prevent such evils. None can dispute the claim that all people are entitled to pure air; and this is what the protracted inquiry and difficult task of this Board in the stench-producing region of Hunter's Point has signified. It is creditable to the managers of the vast industries which caused offenses that the final instructions by the Governor have been so intelligently and heartily responded to. Although the task of controlling and cleansing is not yet completed, the eighth section of the organic law of the Board is producing good results, and it works no serious hardship to any legitimate trade or business. It is found adapted to secure the abatement and prevention of great evils that have obstinately resisted local authorities. The "Three counties act" (chap. 415 of 1851) applied only to New York, Queens and Westchester counties, and it

has presented so many difficulties, even in the simplest cases brought before the courts in those counties, and is attended by so much cost and vexation to individuals who bring action, that it has remained practically a dead letter, excepting in one or two instances.

The Executive instructions and summary orders which the eighth section of the State Board act provided for, tend to prevent litigation, and to secure genuine respect for sanitary conclusions and orders. The fact that parties who are pecuniarily interested in the perpetuation of an evil, may embarrass the proceedings for compliance with the Governor's orders and instructions, by obtaining injunctions, or setting up counter-actions against the party whose duty it is to comply, may not in general diminish the practical value of this law.

Laws and Sanitary Provisions Relating to Small-pox and Vaccination.

As it is a traditional law of the human family that, as regards the small-pox contagion, "the public safety is supreme law," there is no exception to the universal, arbitrary and often rude application of this instinctive rule of self-preservation. Repulsive, terrifying and destructive as small-pox is, there still prevails a kind of reckless fatalism which stupidly waits for the introduction of the deadly contagion before the one great means for prevention is resorted to. Local health boards report that the people wait for a *panic* from this disease before they will seek protection by *vaccination*.

The experience of the State Board, however, during the past year goes to show that by providing certain essential aids to physicians and the local boards of health, and supporting their efforts to secure the proper vaccination of all who are unprotected from small-pox, the indifference and objections to the protecting service of the vaccinator give way to a thankful appreciation of it.

The kind of *aid and support* required, will need to offer *information, plans, occasional guarantees for payment of vaccinal supplies,* or, perhaps supply the *pure virus gratuitously,* and at all times to make the State Board a centre of information, advice and action *for the perpetual suppression of small-pox.*

The Committee on Vital Statistics has submitted a statement that shows the Board has succeeded in laying a basis for the system here defined. It may be necessary to have the duty and authority of this Board more completely affirmed in the laws relating to this matter. The vaccination law of 1880 (chapter 438) was for the first put in action by advice issued to every town and school district last spring. That law is limited, in its operation to common schools. It is neces-

sary to reach every householder with the language of an *obligatory law and regulation* concerning vaccination, and at the same time to offer within proper limitations, the guaranties of pure vaccinal virus, and of gratuitous supplies of it for the poor and to meet sudden exigencies of local boards of health. Some details on this subject appear on a subsequent page. The terrible enemy to be disarmed and destroyed by sanitary organization and vaccination will stalk up and down through all communities that do not thus organize and act efficiently, and it should be remembered that until vaccination was discovered, the whole civilized world was in mortal dread, for as the great historian Macaulay, said of England, "small-pox was always present filling the churchyard with corpses and leaving on those whose lives it spared the hideous traces of its power, turning the babe into a changeling at which the mother shuddered and making the eyes and cheeks of the maiden objects of horror." Against an enemy and destroyer so dreaded no sane citizen should deny the right and duty of applying such obligatory laws as are necessary for the complete protection of the people.

Impure Water Supplies; Pollution of Wells and Streams; Water Analysis.

The filth-soakage, which is known as a cause of fatal disease wherever it occurs in connection with wells or other sources of domestic water supply, is found to have all the importance that was attached to it in the Board's first report. House epidemics of diarrhœal disease, and the typhoid fevers as reported to this Board seem to have resulted chiefly from this one filthy cause.

The pollution of streams as well as of grounds that surround the nearer sources of domestic supplies of water has been carefully investigated in numerous places. The appended report upon chemical analysis of water-supplies unfolds the fact that in some instances the most positive defilement and unfitness of water was not revealed and explained so much by quantitative chemical analysis, as by the actual suffering of those who drank the polluted water, or by odors and minute kinds of proof of impurity. There is reason to suggest that there should be adequate resources of law at the command of sanitary authorities to prevent the pollution of streams, ponds and grounds about wells and springs, used for domestic or potable water-supply. Evidence of the necessity for definite legislation to prevent this cause of danger to public health is being arranged at the central office of this Board, while advice and the chemical analysis of suspected waters are offered to all local authorities who need such aid.

In a report from Engineer Egerton, which will be found appended

in the papers on Sanitary Drainage and Topography, it is shown that the soakage from a butchery and swine-herd on the margin of the reservoir of a private water company, which is supplied from the Mohawk river, was an obvious source of impurity. The chemical analysis which was made of that reservoir water by Prof. Waller found only a small percentage of organic impurities; yet when heated to 100° Fahr. the water gave off offensive odors characteristic of the animal filth that defiled it. In like manner it appeared in the analysis of the water that killed nearly an entire family west of Ithaca last year, that the excremental pollution of the family well had more importance than any thing that was revealed in the chemical laboratories in which the water was carefully analyzed.

This board while offering to every local board of health the resources of the best chemical laboratories for water-analysis, has no hesitation in advising that purity of source and surroundings of the water-supply for domestic use must be regarded as paramount to any thing that chemistry may be expected to reveal; and that in addition to being pure, the supply of such wholesome water should be in a sufficient quantity, and its source be carefully guarded against all causes of defilement.

The General Drainage Laws.

As laws relating to drainage are co-incident with the history of civilized States and their legislation, New York has shared with other States the promiscuous kinds of law-making on this subject from almost the beginning of its organization as a Commonwealth; but in 1869, an act amendatory of the Revised Statutes relating to general drainage was adopted, with an obvious intention to secure the systematic drainage which certain portions of the State greatly need, and which each of those populous regions, namely, Seneca, Northern Cayuga, Onondaga, Wayne and portions of Monroe, Orleans, Niagara and Genesee counties, alike called for at that period. Portions of Orange, Richmond, Queens, Westchester and various other districts in the State required, and still require, the operation of such a comprehensive and equitable general drainage law as shall be adapted to remove the general obstructions to the outflow from swamps and marsh-lands, to secure thorough drainage for health as well as for wealth.

Such, undoubtedly, was the object in view by those who prepared and enacted the General Drainage Law of 1869 (chapter 888), and its amendments in subsequent years.

In the practical operation of the law, and its amendments, grave difficulties and obstructions have arisen, which the legislature will need, sooner or later, to provide against.

The fact that swamps, marshes, stagnant and fluctuating ponds, foul streams and wet lands, have an important causative relation to miasmatic diseases, and to certain maladies that are still more fatal, is admitted to be so true that in the interpretation of the General Drainage Law of 1869, the courts have held that unless the proposed drainage is necessary for the public health, the County Court does not acquire jurisdiction for the enforcement of that law. The condition under which the initial proceedings for drainage are taken under it, is, that "any person or persons who shall deem it necessary for the *public health* that any such swamp, bog, meadow, or other low or wet land shall be drained, may present a petition, duly verified, to the county judge, etc., etc." Though public economy and private advantage might justify an obligatory general law for drainage, the interests of public health are first in order, and they really are paramount.

Faulty as this law now is, certain miasmatic districts have been greatly improved by its application, yet as mentioned in this Board's report a year ago, the drainage laws of the State are practically inoperative and have been the occasion for abuses which the legislature did not foresee. For this and various other reasons which will appear in the presentation of the special report, herewith submitted, — showing what are the essential requirements in a general drainage act,— the board now earnestly invites the attention of the Governor and legislature to the existing necessity for such a general statute as shall adequately provide, 1st. For thoroughness and efficiency in the service and plans that relate to the drainage of extensive areas of swamp and wet lands, in regard to which the State has a responsible concern, especially through all those districts in which the canal-feeders and their storage-lakes and ponds are situated.

2d. That every county, town, village and city shall be authorized and enabled by statutory provisions, to devise and proceed with such general drainage, as the judgment of local Boards of Health in the districts concerned, confirmed by the State Board of Health, shall advise. And that the plans for such drainage, whenever they extend beyond the limits of an incorporated village, township, or city, shall be approved by the State Engineer and the State Board of Health.

Perhaps it is not practicable for any State authority to interfere with the preference of tax-paying citizens for the purpose of obtaining for them the sanitary drainage necessary for the protection of health and life in their families, yet there have been brought to the attention of this Board certain instances of great public necessity for sanitary drainage which ought not to be delayed for another year ; but in certain communities that are so unsettled in their local judgments and action, whole neighborhoods would take the chance of sickness half

the year round, and a considerable addition to their mortality, before any united action and taxation would be undertaken by them for deliverance from miasmatic diseases. The citizens of Memphis, Tenn., lived, and thousands of them died, in this dangerous way, until annihilation, or action, became inevitable alternatives. This Board makes it a special duty to enlighten and counsel the communities in order that they may act earnestly and intelligently.

Every local Board of Health is likely to have occasion both to recommend, and require, certain kinds of local drainage, the removal of obstruction to streams, and the drainage and filling of pools and sodden grounds. To accomplish these minor works of drainage promptly and properly, the general drainage act may well confer upon local Boards of Health adequate power to cause the proper execution of such sanitary works. The great evils which have arisen from the exercise of that authority in the Drainage Act of 1869 and its various amendments, by which the towns and counties in which the drainage is to be executed shall issue bonds or certificates of indebtedness to secure the performance of the work, has led to such grave evils, that a better way must be devised to encourage, and enable, the people to protect themselves against the harm of swamps and malarial grounds. It may be worth the attention of legislators and publicists, to notice the beneficent operation of the English Local Government laws, under which the State itself offers to loan, on easy terms, a certain per centum of the total sum that is found necessary by any local government, or parish, or other civil division, for sanitary administration, for the completion of such drainage and other improvements as the local authorities decide to undertake. The laws here referred to have been in operation now for nearly ten years with the most encouraging results. The loans, though moderate, have produced remarkable advancement in the public welfare of hundreds of places. The financial obligations thus incurred are promptly and thankfully honored, and this system has put an end to all speculative methods of bonding and town indebtedness at the discounts of the brokers' market. It is unnecessary in this place to make specific reccommendations as to what should be done, but it is so important in this State that a General Drainage Act should be well framed, and if possible, should become a law before another summer, that this Board's committee on Drainage, Sewerage and Topography will respond to any call of committees of the Legislature that take this subject in hand.

Though there is a vast extent of swampy and other miasmatic areas in the State of New York, it is chiefly important at present, and for several years to come, that such sources of malarial and other diseases, which drainage and the drying of grounds alone can overcome, should

be removed as promptly and thoroughly as practicable from the midst of, and near the vicinity of the more populous and much frequented districts; for at present we judge that fully one-half of the entire population of the state is dwelling in the immediate presence of such sources of malaria, as may, and should be removed by the adoption of general and local measures of drainage of those districts, and local sanitary improvement of the dwelling-grounds and the site of hamlets and villages.

In numerous places the drainage works that will be found necessary for removing the sources of *miasmata* in a village or populous neighborhood cannot be successfully or economically executed without extending in such directions and to such distances as to remove the local causes of malaria from the entire series of villages and hamlets. In the counties of Richmond, Orange, Albany, Wayne and Genesee this fact is obvious.

The natural drainage-areas when treated for sanitary purposes, require the engineering and scientific knowledge which the State now permits this Board to employ under a provision of the law defining its duties. In responding to numerous requests from local authorities, especially in the cases that have been referred by the Governor to this Board, it has come to pass, that in the first steps toward the real and permanent prevention of evils complained of in regard to malarial and other diseases, it has been necessary to employ such engineering and other scientific aids as should secure the best results with the least expenditure. Certain records of procedures thus taken are submitted herewith. The two reports upon the drainage in the Genesee and Canaseraga valley, and the one relating to systematic drainage required in the regions near Batavia and Tonawanda, or the drainage areas of the Oak-orchard and Tonawanda creeks, supply some illustrations of the necessity for a comprehensive treatment of general drainage questions. The special reports relating to strictly local drainage, such as was found to be necessary in the vicinity of Oscawana island, the city of Hudson and the village of Croton Falls, as also in the region of Southfield, reported upon by Dr. Carroll, show what may be correctly and effectively done to remove local causes of miasmatic diseases by local authorities and the owners of estates.

This Board earnestly commends to your attention, and to the attention of the legislature, the importance of perfecting the statutes relating to general drainage, and at the same time clearly defining the duties and authority of local boards of health in regard to such systematic or special drainage as should be executed by them, independently, within their separate jurisdictions.

Sanitary Drainage of Villages and the Treatment of Drainage-areas in Populous Districts.—Disposal of Domestic Waste Matters.

Most villages are so located with regard to streams and ponds of water and their natural drainage or water-shed, that a systematic treatment of the outflowing from each factory, stable and street, is an obvious sanitary necessity; yet until the present time only a few of our villages have given heed to this matter in such manner as suitably to protect the public health.

The disposal of domestic waste material and of all excremental matter is of the same sanitary importance in villages as in cities. Indeed, it is of like importance in and about every dwelling. The family-well, the stable, the pig-stye, the cess-pool and the privy, have hitherto been grouped and located about the cottage and mansion, with strange disregard for natural laws of health and purity, as shown in this Board's former report. Fatal fevers, blood poisoning and bowel diseases in villages of greatest natural salubrity, may be readily traced to this vicious saturation and filthy soakage of excremental and foul matters about the dwelling. To avoid and effectually prevent this class of evils, in villages especially, it is necessary that, under local sanitary orders and regulations, there shall be systematic and faithfully enforced provisions for drainage and a safe mode of disposing of all excremental matters. Without entering at large upon this subject the Board would here bear testimony to the imperative necessity for systematic drainage and suitable sewage-delivery to protect the public health in every village.

The examination of numerous villages, and some of the smaller cities, by this Board during the past year, confirms the judgment here expressed that, in every village and hamlet, as well as in every city, the entire drainage area within its jurisdiction and even beyond such jurisdiction, the *natural drainage areas,* should be surveyed and treated as the fundamental part of a sanitary system necessary to the protection of life and health in such populous communities ; for unless this foundation is laid, upon which the purity of dwelling sites and wells and of the atmosphere shall depend, then no affluence of the dwelling, no superior intelligence in the family, and no degree of anxious care of parents and of house-holders can secure the protection, which every domicile and individual—even the humblest—ought to enjoy. The Board takes pleasure in presenting a statement hereto appended by the chairman of its standing committee on drainage, sewerage and topography, who undertook during a visit in Europe the past summer, to examine into the practical results of drainage and disposal of waste and excremental matters in villages and small towns.

Public Obstructions to Natural Drainage — Sanitary Questions Connected with the Abandoned Canals and the Malarial Pools and Grounds near the Erie Canal.

This Board has had its attention called to no less than fifteen instances of obstructions to natural water courses, caused chiefly by railroad embankments. The right of "eminent domain" is everywhere regarded as carrying with it the corresponding obligation to prevent the use of that right and the franchises acquired under it, from being a source of injury to health and life. Some details which illustrate this subject are given in statements here appended concerning miasmatic nuisances that have been complained of to this Board, and by it brought under investigation. It is believed that in the instances here referred to and perhaps, generally, the railroad corporations will satisfactorily respond to the requirements of local sanitary authorities and to any recommendations of this Board which the Governor may order to be complied with. Special obstructions that were created in the course of construction of the Erie canal, and especially of the numerous "feeders" have been brought to the attention of this Board. Several of them have been examined and at present it appears to be true that the entire system of "feeders" and the canal itself, may readily be made to facilitate and protect the sanitary drainage of the immense stretch of the country through which this water-carriage system extends. Though it does not do this at present and in all places, it should be made to do so. It is worthy of remark, in this place, that medical and sanitary observations along the entire course of the Champlain, or Northern canal, from Troy to Lake Champlain, and along the late Chemung canal, especially in the Catharine Creek valley, where drainage works of the abandoned prism have just been completed, show that the miasmatic diseases of those regions were not only greatly diminished, but had nearly if not wholly disappeared for many years following the completion of those canals. The canals need not and must not become sources of disease.

A peculiar and unthought of cause of obstruction and of great nuisance and danger, has occurred along the course of the western terminus of the Erie canal. Beginning at the Hamburg street *cul de sac* at the western terminus of the great canal, the total sewage of Buffalo and of all other places that can pour their filth into the canal, along the entire distance through Erie and Niagara counties, has at last so polluted and obstructed the canal as to convert it into an elongated cess-pool and stench nuisance, all the way from Buffalo to and beyond Lockport, a distance of thirty miles, and upward; while Buffalo, Black

Rock and the two villages of Tonawanda are already suffering a penalty — that of nauseating sickness, and an increased mortality — in consequence of this prodigious nuisance, all who live near the canal and even the entire city of Lockport, miles away from what is known as the Hamburg street canal nuisance, are suffering all summer and even until the frosty season, from an evil they cannot avert. It is justly demanded by the people of that region that the State shall forbid and prevent the obstruction and pollution of this great artificial water-way. There is reason to believe that the city of Buffalo will be constrained to put an end to this evil in sheer self-defense. This Board carefully investigated the facts here referred to in the summer of 1880, and fully coincided in the conclusions of the expert engineers, whom that city had called in counsel with it.

There have been frequent occasions for this Board's advice concerning obstructions, misuse, and defilement of certain unused "feeders" and "basins," and other stagnant reservoirs and ponds and streams of water, contiguous to the Erie canal, and the facts thus far observed will warrant the suggestion, which the Board would here respectfully make, that by means of a moderate appropriation, and suitable amendments of law, the State Department of Public Works should be authorized to make certain necessary improvements for removing the well-proved causes of injury to public health, which are beyond the control of the local authorities, upon the property within the jurisdiction of that department, as shall be recommended by the State Board of Health, approved by the State Engineer, and ordered by the Governor.

Though it may not yet appear to be demonstrated that any special legislation is necessary to secure the requisite action of railroad corporations, and the owners of mill-streams and waters used for hydraulic purposes, there are some very important questions relating to this subject, to which, no doubt, the attention of the Governor and the Legislature will be called by citizens, and by localities that are suffering from existing obstructions to natural drainage.

The Extent of Preventable Causes of Malaria in the State.

Though the present is not a proper time for stating what is the extent of *paludal malaria* in the State of New York, this Board has begun to ascertain, with reasonable accuracy, certain limitations of its recent prevalence in the different districts in which it occurs. These limits are found to have reference to the altitude of localities, the accumulation and decay of vegetable matter, the saturation and drying of grounds, or more properly, the fluctuation of the levels or

planes of saturation ("ground-waterstand") in wet grounds, and muddy bottoms; the stagnation of ponds and pools, and the fluctuations of their muddy margins; the partial and irregularly saturated condition of dwelling-grounds and village sites, the wet cellars; and all those conditions, domestic, local and climatological, which may be connected with any of these causes of disease.

While it is probably not true that all swamps are miasmatic, and that all saturated grounds are necessarily so; drainage, culture-cropping, drying and the general cleanliness of dwelling grounds, streams and ponds, are the known conditions upon which we must depend, mainly, for the prevention of paludal malaria, in those regions which are within the altitudinal range of its occurrence in this latitude; as nearly all parts of the State, that are situated within the lines of altitude, not exceeding 800 feet above tide level, are subject to the occurrence of malarial disease, when the conditions here first mentioned are present, the sanitary problems of prevention of it are worthy of all the study they will receive.

With a view to the foundation of correct and well-verified observations upon the ascertained conditions and limitations of miasmatic diseases throughout the State, and a correct medical statement of experience in regard to the times, places, circumstances, and results of the occurrence of malarial fevers and phenomena, the Board directed its committee on vital statistics to organize a method of inquiry for this purpose, to begin with a circular that should glean the best information from the medical profession in the State. This circular, and the body of evidence on the subject is presented in the accompanying appendix. The Board would notice the fact that, although it has become as common for persons, whose interest it is to do so, to deny or obstinately question that paludal malaria is known to be caused by any earthly thing, as it is for others to deny that there is any harm in fever-and-ague, yet malaria is a blighting evil, and miasmatic diseases are destructive. Whoever, and whatever, will remove and prevent its causes will confer measureless benefits upon the people, and add to the average of human life in the State of New York a large per centum of vigorous strength, general health, and length of days.

Sanitary Inquiry Relating to Prevalent Acute Diseases.

Though the deaths in this State are being recorded from causes which the physicians subdivide into hundreds of kinds, by different names, there are some five or six diseases which destroy more than half of all who die; about one-half of these perish by acute and contagious

diseases, which sanitary science has proved to be among the most preventable of all maladies that flesh is heir to. Small-pox, diphtheria, scarlet-fever, measles, typhoid and typho-malarial fevers are diseases which the local Boards of Health as well as the State Board must oppose with whatever means the public health laws, and the resources of sanitary science, can offer. Other prevalent diseases which demand timely sanitary interference have been fatal in many localities. Measles and whooping-cough add their full quota to the preventable mortality which before long the people will learn more and more to guard against. Important investigations have been made in the localities where diphtheria, small-pox and fevers have prevailed. Many of the facts, gathered in these investigations, have been well quoted by the standing committee on vital statistics to whom this kind of investigation is intrusted. The results of this study appear in their place in the appendix.

The local Boards of Health are enabled by a very simple method of classified statements, upon cards prepared and furnished by this Board, to communicate to the central office the necessary information to enable the central to unite with local Boards of Health whenever informed of prevailing fatal disease. One of the most important procedures against the prevalent and wide spread contagion of small-pox was conducted by the local health authority of Buffalo, in a manner and with results which have been described in a brief report upon this subject in the appendix. Further proceedings to limit the extension of small-pox were taken by the Board at its meeting in May, with the design to contribute effectively to the prevention of the spread of small-pox along the pathway of immigrants, traveling from the Atlantic to the Western States and the Pacific. The means of information which are necessary for prompt action and for the useful co-ordination of the efforts of the National Board with the State Boards of Health has now been matured, the President having approved of the plan which has grown out of the propositions agreed to by several of the State Boards. It is a remark worthy of repetition in this place that, as regards the destructive pests which are spread from place to place by a contagious element, contagions current in the cities are on the railroad or highways of travel carried into the remotest villages and may be spread to every town. For this reason and others, the observation and records of prevalent diseases must be maintained, and in this State it is now required by law. The local Boards of Health must report these facts, and the State Board is required to give whatever advice and information it can for the purpose of repressing infectious epidemic diseases.

The State System of Registration of Births, Deaths and Marriages.

In accordance with the seventh section of the organic law, creating the State Board of Health, the State system of registration and vital statistics has become sufficiently well organized to warrant the conclusion that the two most essential purposes which the Legislature had in view, in ordering that there should be a State system, as well as a local one, for publicly registering births, deaths and marriages, will be attained. These two purposes are :

First. That there shall be a central or State System of Vital Statistics.

Second. That in the development and maintenance of the central system of records of births, deaths and marriages, there shall be such local registration as will equally serve the sanitary, legal and economic interests of the people in their primary communities, and the highest interests of public economy and hygiene of the State as a whole. These two leading purposes became practically the equal and necessary parts of the whole system.

In 1847 the statute that provided a way by which the people in every county, city and town should keep their records of the three kinds of events that concern all families, and should be insured to all individuals, was left to execute itself; hence it remained a dead letter of law. Yet under that law, and the additional statutes, 322 and 512 of 1880, the State Board of Health has been able to lay the foundation for the State System of Vital Statistics. The important amendment of the general statutes, prescribing the organization, and defining the powers of local Boards of Health, as enacted by the Legislature in the summer of 1881, now enables every municipality, township and incorporated village to secure the complete and accurate local registry of its vital statistics.

Up to the present time the duties pertaining to this registration depended chiefly upon voluntary, and not enforced compliance with the directory language of the statute. No penalties have been directly imposed by the laws, and no salaried officers created. The compensation of persons, officially employed to make the registry, has been left in all instances to the local authorities. The law, chapter 512 of 1880, provided that the County Board of Supervisors should determine the compensation to which officers of school districts, towns and counties, rendering this service "shall be entitled," and provided also that the amount of compensation so authorized "may be audited and allowed by the Board of Supervisors of such counties."

The organic law of this Board requires that the "State Board of Health shall recommend such forms and amendments of law as may be deemed necessary for the thorough organization and efficiency of the registration." This Board is also required to "prepare the necessary methods and forms for obtaining and preserving such records, and to insure the faithful registration of the same in the several counties, and in the Central Bureau of Vital Statistics at the Capitol of the State." Thus the law and the distributed responsibility for securing the registry of vital statistics in the State, were found at the time the Board commenced its service, in June, 1880, and any degree of useful attention to these laws manifestly would depend upon the success of the State Board in its relations to the Boards of Supervisors in the counties, and upon such influences and helps as could be brought to the aid of town clerks and clerks of school districts throughout the State. The last Legislature, just before adjournment, July, 1881, enacted an amendment to the general statute concerning local Boards of Health, having incidentally a useful reference to the proper supervision of the primary records, and their registry in the towns and villages; but the influence and usefulness of this amendment depends upon the effectual organization of local Boards of Health throughout the State.

The clerical duties of the registration remain, unless the local authorities otherwise direct, in the same hands which the former statute had designated, namely, in town clerks', and specified clerks in cities and villages. This amendment of law directs: "It shall be the duty of the Board of Health in each town, village and city, to have the supervision of registration of deaths, diseases, and the causes of death, and by its appointed officers, to examine all certificates and records of deaths and findings of coroners' juries, and to designate persons, who shall grant permits for the burial of the dead. . . . To supervise and make complete the registration of births, deaths and marriages within the limits of its jurisdiction."

The State Board of Health has therefore, during the past six months made it one of its duties to induce the organization of the local Boards of Health, as provided under the act here referred to, and immediately to aid and advise in the proper organization and beginning of the work of registration in each town, city and incorporated village.

What appears now to be most important in the experience of the local Boards, as well as of the State Board of Health, in this endeavor, and the duties imposed upon local Boards of Health may be briefly stated as follows:

A large majority of the people in the State have not, until recently,

understood, or even had much thought about the importance or the duty of registration of records of the marriages, births and deaths in their families, or in the community; and, with the exception of church records of marriages, and of the baptism of infants, as recorded by only a small number of the clergymen and priests, there has been no registry of those important events, excepting in a few of the cities; but even in none of the cities have these two branches of registry been at all completed.

The State laws now require that every birth and marriage shall be recorded as prescribed in forms prepared by the State Board of Health. Records of mortality, though until within the past year wholly neglected throughout the State, excepting in six cities, are now justly regarded by all enlightened people as a necessary duty connected with public health service. No objections have thus far been met with in the efforts of the State Boards, as well as of the local Boards, to secure prompt and faithful registration of deaths and their causes in every community. All the local Boards of Health thus far express entire willingness to carry the laws and regulations into full effect, as regards complete and correct certificates and registration of deaths, and the proper regulation of the movement and burial of the remains of the dead. The only source of delay in giving full effect to this branch of registry and vital statistics, consists in the slow, and somewhat tedious process of inciting and maintaining the necessary activity and competent supervision of local Boards of Health. To attain the desired completeness in this branch of vital statistics, the State Board will have to persist in its efforts for successive years. Indeed, in every country where there is successful registration, the central and directory government of it is more ceaseless in its surveillance and instruction than any other branch of public service. The study of the causes of mortality and disease, and the preventable sources of them that are continually filling new-made graves, are now counted among the first sanitary duties in all civilized countries. New York will no longer be counted among the States that are neglecting this duty. Hitherto all attempts to secure such registration in this State have failed, except so far as five or six city Boards of Health have enforced and provided for the duty. Henceforth every township, village, as well as all the cities, will be without excuse for any neglect or defect in the registry of mortality and its causes. Every human life is justly to be regarded as being, or having been, so important among the units and aggregate of the community that its record must be kept according to the laws and forms which the State prescribes; and, that notwithstanding death is the last epoch to be attested and registered in the public records, this final registry must gather up, and briefly, but accurately,

identify the individual, protect the name, and all the social and State interests connected with it, by records of the causes and circumstances of death, faithfully inscribed upon the public registers of mortality, so that it shall contribute to the knowledge of life and health, and to the art and duty of saving them. This duty is replete in all its parts with importance to the public care of health and life. The State of New York has judiciously relegated to every local Board of Health the responsibility of the supervision and enforcement of registration laws relating to it. *Birth* gives the initial facts for every registration of the individual of a population, whether born to honor and wealth, or to dishonor and penury. Each community, as well as the whole commonwealth, has such concern and responsibility for the welfare and rights of every human being within its jurisdiction, that the records of the birth, and all its legitimate heritages, will ever be regarded as dutiful in a civilized country. To deny, or oppose, or deride this duty of public registration of births, is to promote a condition of barbarism and injustice to individuals who are deprived of a registry of facts which may fail to be so attested and inscribed, as to secure their normal rights, and such honor and hereditaments as should appertain to them. The physiological and hygienic truths with which these new lives are ever associated, if correctly observed and recorded by suitable methods for tracing identity of relationships, ages, social and industrial conditions, etc., will be found to be of greater and greater importance, and of more and more dignity, as well as physical concern, as the number, completeness and accuracy of birth records go on increasing.

It is proper that this Board should here state emphatically that the birth registers are not in danger of having inscribed upon their pages records of dishonor and vicious heritages; there is not a public register of births in this State that is liable to contain such things. Even the records of illegitimate births are made with all proper care and completeness without violating this rule. There has not yet been an instance of any grievance given to any family or, so far as we can ascertain, to any individual by means of the birth record.

So important are the registry records of the individuals who are added to the population by birth, that in all civilized countries it is made the duty of the State, not only to obtain and preserve these records, but to provide for, and make obligatory, the preparation of the individual records by the first of kin, and by the professional attendants who are responsibly cognizant of the individual birth. The ecclesiastical provision and requirements in this matter were long ago found insufficient, even in England and France; yet the given or baptismal name is important in connection with this branch of

public registration and according to the first general act providing for the birth registry in New York, the registries kept by the clergy of the baptismal name, are required to be suitably accessible to the registering officers. Every registry office is now supplied with name-cards for securing correct returns of the full name of every child.

Marriage, designed and legally appointed, as it is, in the social economy and moral laws that govern the race, to *found the family and successive generations*, makes a class of records that in this State and for the nation will be made public, whether the laws require one or another mode of official registration of facts. While in most countries the registration of marriages is strictly enforced by the *Code Civil*, there is not, and never should be, any disrespect of the *Code Ecclesiastical* by the State and local registering officers.

Thoughtful citizens in all parts of the State of New York have greatly deprecated the want of a system of civil registration of marriages, and the defectiveness of whatever registration has hitherto been required under ecclesiastical regulations in the different religious sects. Faithfully as many of the clergy perform their duty, as they understand it, few of them follow any standard that is sufficiently correct and complete to answer the great design of marriage registration. In short, the ecclesiastical requirements and methods by no means meet the necessities of society, though they may be entirely appropriate and sufficient for the religious or the sacramental purposes they serve.

The State Board of Health finding that the law imposes upon it the duty of prescribing forms and methods for securing correct and complete records of marriages for public registration, has adopted forms which, under the best administration of the civil and the ecclesiastical codes relating to the marriage registry, in the most enlightened nations are giving the best results and greatest satisfaction. The form prescribed under this Board is identical with that adopted in the city of New York and in the city of Brooklyn, where for some fifteen years they have been in constant use. They are also nearly identical with those of Massachusetts and Rhode Island, and of Great Britain Belgium, France, and Germany.

It is creditable to the leaders of thought, and to those highest in authority that in the different religious denominations in the State of New York, from those least under any central ecclesiastical instructions, up to presbyters and revered dignitaries, as is shown by the practice of bishops and of the Roman Catholic Cardinal, their compliance with the duties and prescribed forms of marriage registry, as a civil obligation, bears testimony to their correct estimate of the design and uses of such records. The blank forms for marriage registry are now distributed throughout every county and township in the State, and

have been placed in the hands of nearly all persons whom the statutes permit to solemnize or attest the marriage ceremonials. Thus far this Board has offered all the aid and information which the laws have required it to offer to the people and to all professional persons who are concerned in the sanctity of a public registry of legalized matrimony. Like the registers of birth (which are obviously important for sanitary records and references), the public registers of marriage are kept by the town clerks for the townships, and in cities and incorporated villages, with few exceptions, by the special registering officer or clerk appointed as registrar. Where no special appointment is made, the city clerk and village clerks are the registrars under the statute.

Death and its causes will henceforth, by virtue of chapter 431 of 1881, be registered under the immediate supervision and regulation of Local Boards of Health, wherever such Boards are in operation. The last statute permits and provides that the town clerks and the registering clerks established by law, in villages and cities, *may* still keep, as supervised by the local sanitary authorities, all the records of births, deaths, and marriages. Every Local Board of Health is, henceforth, required to supervise and make complete the registration of births, deaths and marriages within the limits of its jurisdiction. Thus, without repealing any laws relating to registration, the amendment here referred to (chapter 431), supplies for the present, a much needed source of local provision to enforce complete and perfect registry in every community in the State.

As it is only a few months since the towns and a majority of the incorporated villages in this State began to organize their local Boards of Health effectually, the supervision of the registry of vital statistics, and the official regulation of burials, and the transfers of remains of the dead, are new duties with which the communities in this State are now for the first time becoming accustomed, excepting in a few cities in which registration and sanitary regulations concerning burials were established by a local sanitary code. In this gradual establishment of regulations to secure complete and accurate registration of death and its causes no inconvenience and no increased cost need to be incurred. The new laws are working acceptably, and they are now in operation most effectually where the local Boards of Health have become well organized.

Town clerks, clerks of incorporated villages, and justices of the peace have begun to perform their parts in the duties of registration; and in only a few instances has it been deemed necessary by town Boards of Health to designate any other person than the town clerk for the clerical duties of inscribing in the public registers the attested records. In many of the towns the duty of issuing the Burial and

Transit Permits is performed by the town clerk, who, in many widely scattered communities, with the approval of the local and State Boards of Health, is aided by one or more of the justices of the peace, in accordance with chapter 512 of 1880. The report by the committee on vital statistics herewith submitted gives illustrations of this duty, and shows that public convenience, as well as a strict compliance with the laws and the interests of the public convenience, are well respected and secured under these and the various other additions which have been adopted for the convenience and completeness of the service in this branch of the Board's supervisory duty.

The sanitary regulation of burials has been made the subject of so much public discussion in recent times, especially with reference to certain supposed hygienic necessities of returning to the ancient practice of cremating the remains of the dead, that we do not feel at liberty to pass lightly over this matter of regulating burials and transporting remains of the dead by public carriers. Though this Board is not responsible for the framing of the statutes relating to this subject, it has accepted and acted upon them in such manner as to secure the best practicable results with the least possible inconvenience.

The objects in view in obtaining and attesting the personal record of each and every individual who dies are that the identification as regards the individual shall be assured; that the family, the nativity, the residence and the occupation, as well as the sex and age of the decedent shall be recorded; that the most concise, yet correct, statement of the death and causes of death shall be given, and professionally or officially attested by an attendant or other competent witness; also that the place of burial and the person in charge of it, or of the removal, shall be recorded; and, finally, that the local sanitary authorities shall, by suitable regulations, be daily informed of the facts and certified records of causes of the deaths which occur within their jurisdiction.

The secondary objects of this public registry are secured in the attainment of these, the essential ones, for they comprise and require chiefly these specific attestations of facts especially those which relate to causes, residence, age and occupation. The sanitary considerations and in many instances in the cities and towns, the protection of health and of life will depend upon the prompt and faithful transmission of these items of information, to the proper local authorities. As mentioned in this Board's first annual report, one of the most distant school district clerks in the State sent forward, as soon as received, copies of the certificates of five deaths from diphtheria in little children, saying to this Board, "it seems a duty to give this information." Immediately it was ascertained by a sanitary officer that certain neg-

lected localities, as well as neglected contagion from a visitor in the neighborhood, gave the necessary basis of information for applying the means to repress the disease.

In the report by the standing committee on vital statistics, and in statements submitted by the secretary, abundant evidence is presented to show how important it is that the registers of mortality, the pages of which remain closed in no community many days in succession, should be regarded with a watchful concern by local sanitary officers.

In the words of the committee on registration: "Regarded as the ever visible barometer of life and health in the communities of this State, the death rates when read in connection with the local and significant, but variable circumstances of mortality, are so important that every city and district in the State should so keep this registry as to yield the most useful results to public hygiene and to sanitary science."

The organic law of this Board provides that it "shall recommend such forms and amendments of law as shall be deemed to be necessary for the thorough organization and efficiency of the registration of vital statistics throughout the State." Therefore, whatever shall be found necessary will be thus recommended, and the Board is unanimously agreed in now recommending that the Legislature shall confer the necessary authority to enable the executive officer of the Board temporarily to supplement, by means which the Board shall have approved, whatever deficiency is discovered in the duty of registration in any town or place in the State. It is not improbable that at a later period, it will be found advisable by the Legislature to supersede the existing mixed authorities upon which this branch of public service now depends, but the fact that to local and State sanitary authorities the chief duties and first uses of the records of vital statistics belong, must be conceded. It is not improbable that the complete reorganization of local Boards of Health throughout the State will insure the operation of all the necessary agencies and influences for complete as well as accurate registry of births, deaths and marriages in every community. But certainly it seems inexpedient to ask the Legislature to create special offices, and incur any avoidable public cost in a branch of service that is so closely associated with the interest of the public health. The existing official machinery must be tested.

In concluding this statement the Board deems it important to recommend that the certificate of death as now required by the laws of 1880, shall, without exception, be secured and duly examined by the local health authorities before the burial of any person in this State.*

*While this Report is passing through the press an amendment of the general Public Health Law (chapter 351, of 1882), has prescribed the methods of attaining the ends here mentioned.

Though this is at present required by chapter 512 of 1880, it appears to be necessary that this rule and the obtaining of an authorized permit for burial — upon the acceptance of a certificate of death — shall be insured and made invariably obligatory by a few separate words of law that cannot be disregarded by recording clerks, or any other local authorities; for this is a matter quite essential to public order, and to the complete record of death and the causes of mortality. This rule would include all cases that are subject to the coroner's view or verdict as well as all others made under indifferent local administration, of burial without a suitable record of the causes of their "taking off." Shams, shame and fraud will be in this way prevented; while records of mortality in this State shall henceforth be made complete and creditably accurate.

The indecent haste to bury the dead without a record in many instances is but a mask to wrongs that no civilized community should permit to go unsearched and unguarded against. The "Crowner's Quest Law" oftener *fails to find* the true cause of death than to *record* even the probable causes; but whatever it discovers has no registry, except in two or three cities. Human life in various quarters and in unexpected ways is at a discount, while "grave-yard insurance" and other methods of wrong have no restraint in States which disregard the sanctity of life and neglect the registry of death and its causes.

Expert Services:— Engineers' and Others'.

The first service of this kind during the past year became necessary in connection with the investigation relating to the causes and means of prevention of the stench nuisances in Newtown creek district. The best aids of chemistry and some other departments of knowledge were obtained. The Board has found it necessary in the duty imposed by the Governor's orders, concerning these effluvium nuisances, to continue this kind of assistance until the present time. It is believed, however, that it may be discontinued at the end of the present month (December).

Sanitary and civil engineering assistance is required most frequently of any kind of expert service, and has been called for in numerous instances. Some of the results of this appear in the appended papers. Occasionally it has appeared that local sanitary authorities were at a stand still in their efforts to proceed from sheer necessity for a day's service of an expert for some special inspection and advice. The State Board has at once responded to any worthy request of this kind, and thus far, with excellent results. It is fortunate for the success of sanitary work under local authorities that there is a steadily increasing

number of civil engineers, and experts in special branches of the applied sciences and industrial arts, who are preparing and prepared to render practical assistance. It is proper here to express the opinion of this Board that the limited amount of funds which the law of 1880 provides to be expended for such expert work should be increased. There is no doubt it would be wise economy to augment the total appropriation for this Board's service to such an extent as to authorize an expenditure not to exceed ten thousand dollars annually in payment of the various kinds of expert labors employed in accordance with section 10 of chapter 322, of 1880. Though some of the members of this Board themselves perform much of the expert labor required in the service, they cannot justifiably undertake all this kind of duty. They share it in every instance, and are aided by it in their most responsible undertakings.

Health in the Schools.

The interests of health in the public schools could not, without wrong to the people, be overlooked by this Board. These interests are identified with the health and happiness of the families of the State. They are in the best sense public health interests. Individual life and the immeasurable value of lives sound and vigorous, and of minds and moral natures which are both truly educated and in high health, are the richest treasures of a State as well as of individuals. This is the standpoint from which to view the whole subject of health in the schools.

Early last winter the correspondence of the Board and various questions that were appealed for advice and instruction, showed that there is need of sanitary supervision of schools in cities and populous villages. Certainly there is reason to maintain a practical kind of sanitary inspection of school-houses. Small-pox, diphtheria and other contagious maladies appeared in various parts of the State to be so facilitated in their propagation by the assemblage of pupils in crowded school-houses, where those contagions gained entrance, that how to apply the necessary means for preventing the local conditions which favor the spread of contagious and other maladies through the common schools became a most important and practical question.

The first appeal to this Board was in the nature of a protest which had been transmitted from a village of nearly ten thousand inhabitants, in which a school officer claimed that the village Board of Health and the School Board should not be permitted to carry into execution an order then just issued to require the vaccination of all school children. In this case small-pox appeared in certain families that sent their children to one of the largest schools. The appellant

was advised by this Board to give his support to the action taken by the local authorities as a duty toward the public at large, and that he should merge any personal and theoretical objections, in order to secure the greatest general protection and the public welfare. That gentleman promptly adopted this policy, and at once had his own children vaccinated. This was an important concession by a wealthy, influential and most worthy citizen, whose timely example established the success of vaccination in the schools. The great school which was closed by the authorities was opened in less than a week, and the pupils returned with evidence of having complied with the rule as provided under the statute of 1860. In various instances there was such delay in vaccination that it became necessary to urge that certain common schools should be temporarily closed. In one instance in Sullivan county, the teacher of a large district school, when small-pox had been introduced by a pair of slippers that had been taken from a small-pox hospital, 100 miles away, so opposed the request that his school should be temporarily closed, that a large proportion of his pupils and a great number of families were attacked by the contagion. It spread through the township, causing great alarm and suffering, and killing no less than six of its victims.

Diphtheria has appeared in so many schools, and, like scarlet fever, has proved so terrible a destroyer of child-life, that this Board, during the winter of 1881, ordered the issuing of a circular of information in concise and practical terms. This duty has been extended to the subject of infections and contagions in general, and, specifically, to the sanitary repression of diphtheria, scarlatina and small-pox.

The fact that the clothing of the children, the apparatus and furniture of school-rooms, the water and drinking-cups as provided in common schools, and especially the contaminated atmosphere of the crowded school-rooms themselves, and the ready communication from person to person of the unseen infectious causes of each of these diseases, induced this Board to direct its Committee on Public Institutions to prepare a plan, with suitable methods for such sanitary inquiries and the diffusion of such practical suggestions by means of a circular of inquiry or otherwise, as shall incite action that will protect the health and lives of school children throughout the State.

The proposed plan of inquiry for this purpose has been the subject of much study, and is now one of the organized branches of this Board's public duty. It extends to all the essential conditions which should be provided for the security of health in schools and seminaries.

This subject proves to be so full of interest to teachers and officers of schools, and to parents and guardians of pupils, and such are the results of the present systematic inquiry and suggestion of sanitary

duties which everywhere attend this research, that the Board has no doubt that it is expedient to keep up this service until every school-house in the State shall have been brought into a safe sanitary condition, and until teachers, school officers and parents alike shall comprehend the duty of guarding against preventable evils to the health and physical well-being of school children. The subject is presented in the report of the standing committee on public institutions, and in carefully studied statements prepared under the direction of the board, by Dr. David F. Lincoln, of Geneva, an expert in school hygiene, who for several months has been engaged in a critical examination of school-houses in several of the counties.

This branch of sanitary service has extended to all classes of public schools, and the Board believes it is sure to prove a most comprehensive means of protection to health in schools and families. Events in some of the large collegiate institutions in other States, and several instances in this State, have within the past few years given sad illustrations of the local causes and destructive prevalence of diseases which are in an absolute sense preventable, and whose prevalence in any college or other school, must be recognized as proof of culpable ignorance and neglect of sanitary duties.

In thus organizing a branch of special sanitary effort for protection of the health of children, it is designed to contribute the best means of information and security, without seeking to interfere with the official responsibilities of those who must be held accountable for the schools and whatever occurs in them. Evils are to be prevented, and the inspection, counsel and suggestions incident to this branch of duty cost the State but little, yet the results will be among the best which this Board can secure. Informed and forewarned, those who are responsible should be fore-armed for the prevention of harm to health and life of school children.

TENEMENTS. — PROTECTION OF HEALTH AND LIFE OF TENANTS.

As the sanitary supervision and interests of the tenement population in our chief cities now demands the most important kind of public health service, and has presented numerous vexed problems in legislation and in local administration, to secure the general protection of public health as well as the protection of the lives of the tenants, so it is found that whenever numerous poor families are housed under one roof, entering through one doorway and using, in common, those dwelling facilities that among the rural population and the more affluent in the cities, each family separately possesses, the massing of large families in close quarters, or the crowd-

ing together of badly appointed tenements, upon the ground-level; all alike conduce to the crowd-poisoning and filth diseases which prove the necessity for immediate and adequate provisions of law to limit and regulate the very abuses and evils which the inhabitants of rented tenements do themselves ignorantly induce and suffer in their domiciles, for the fitness and preservation of which they take little or no heed. With more than half of the families in the State dwelling in cities, and with nearly one-half of these, at least in the metropolis, crowded in what the law defines as "tenement houses," the State Board of Health regards with just concern all those sanitary perils and public interests which such conditions of habitation and life of the more ignorant and dependent classes imply. For this reason a brief practical statement of facts which concern the State, and have a direct relation to public health, as connected with the tenement-house population in cities and manufacturing villages, is submitted in a subsequent division of this report.

This subject has, in the view of this Board, acquired great importance since it has been proved in the crowded metropolis itself, where great peril to life and public health was increasing with the crowding of tenements — that intelligence and capital can be successfully invoked to prepare suitable and really healthful dwellings for the poor classes, and where the local sanitary authorities are at last required by law to prescribe the definite conditions of space, construction, light and ventilation which owners and builders shall provide in all tenement houses.

That such legislation secures the desired result is shown by the fact that since the amended Tenement House act for New York city became a law, about three years ago, there have been erected in that city alone tenement and apartment-houses sufficient for the accommodation of 100,000 persons, the plan of every house having been previously passed upon by the local health authorities, and the owners and architects having been required to comply with such rules and regulations as would secure light and ventilation for every occupied room.

Equally satisfactory conditions of sanitary protection are being devised in certain manufacturing towns where the capital which controls and develops the industries has been at the same time applied in the construction and sanitary outfitting of healthful dwellings for the family and tenement homes of operatives. In one instance the Board has found upward of nine hundred brick dwelling-houses so constructed and controlled; and in this instance the factory owners have for the past year maintained an accomplished sanitary inspector for the hygienic supervision of their dwellings and the factory, and for vaccinating and otherwise protecting their thousands of employees.

The military maxim that "Health is the strength of Armies," is found equally true in the cash value of employees and in the strength and wealth of the State. The sanitary improvement and public care of life and health of the tenement populations must henceforward be esteemed necessary in repressing the preventable causes of pauperism, misery and crime. Public health is in danger whenever the sanitary safety of the poor is disregarded.

In concluding this report the Board is glad to bear testimony to the sincere and practical interest evinced by the people in whatever they correctly understand concerning the means for protecting health and life; and it has been an obvious duty to so devise and conduct the Board's work as to contribute as much as possible to the knowledge and practical understanding of the questions and attendant duties which most affect the sanitary interests of the community and all classes of inhabitants. Without separate powers of its own to interfere with local and individual affairs, yet with duties which have compelled it to advise and contribute to sanitary efforts in every town and every school district, the Board has received from the local officials and all other citizens the respectful attention and deference to its counsels and requests which are essential to proper understanding and discharge of sanitary duties. The only exceptions to this general acquiescence and responsive compliance have been caused by certain delays or failures of county or town authorities to provide the means prescribed by law for the performance of certain local duties. In this matter, as in that of an invariable and obligatory maintenance of the local sanitary regulations and registry duties, there may be a necessity for a few simple amendments of laws; but no change is necessary in the spirit or policy of the statutes, which both recognize and fully sustain the local authority as being responsible for the maintenance of these obligatory duties.

In the belief that the organization of local Boards of Health throughout the State will soon be complete, the State Board will continue to devise and maintain the labors which, in common with the movement of the best citizens in every county, will induce and shape the most definite plans and comprehensive methods of sanitary improvements and enlarged resources for the protection of health and life. The enhanced real values and useful outcome of the lives which are blessed with health and all that hygiene in the family, the school, the community and the race would imply and promise, are the awards that wait upon enlightened and faithful care of health in the State as well as in the family and its successive generations. The miserable and unfortunate of the present time might, with some relief to themselves, die, and be buried with other burdens of the community, yet the

identical causes of the same miseries and burdens of the people would reappear if the sanitary and moral resources of knowledge are not interposed. Even the unworthy and wantonly perverse classes of society have to be reached by the beneficence of hygiene in order to protect the community at large.

The spreading infections which destroy children are domestic and neighborhood pestilences of rich and poor alike, and they strike down the fairest and most promising of the young lives ; while malaria and the fever-poisons, which afflict the humblest laborers and their families, also vex and prostrate any other persons who inhale or drink the same unseen and unsuspected causes of these diseases. The public care of health is for the benefit and protection of all classes and ages alike. Its preventive, watchful and humane provisions and advice among the needy and the reckless, its ceaseless inspections and searching for causes of disease and untimely deaths, its faithful enumeration and registry of the dead, and its timely inquiries and instructions, must extend to all ranks, ages and places in the State. This view controls the policy and incites the efforts of this Board in all the relations it sustains to the people.

Respectfully submitted,

EDWARD M. MOORE, *President.*
ERASTUS BROOKS.
J. SAVAGE DELAVAN.
WM. M. SMITH.
JAMES T. GARDINER.
JAMES G. HUNT.
C. F. CHANDLER.
HAMILTON WARD.
ELISHA HARRIS, *Secretary.*

AN ABSTRACT OF THE MINUTES AND TRANSACTIONS OF THE BOARD.

FIRST QUARTERLY MEETING OF THE BOARD IN 1881.

ALBANY, *February*, 9th.

All members in attendance except Prof. Gardiner, who was absent from the State.

The chairman of the sanitary committee submitted the papers which had been referred to that committee relating to effluvium nuisances in the Metropolitan District, and upon his motion it was

Resolved:—That a special committee be appointed by the chair to proceed to New York city to take testimony with regard to the nuisances alleged to exist there in the petition of citizens referred to this Board for examination by the Governor, under date of January 5th, 1881, and that this committee be authorized to employ a stenographer, and such experts and agents as may be necessary to complete the investigation.

That the memorial of citizens with the reference to the Governor, be referred to this committee, and that such special committee report to this Board the evidence taken with their conclusions thereon, with all convenient speed.

The following commissioners were appointed to be such committee for this investigation: Dr. J. Savage Delavan, Hon. Erastus Brooks and Dr. Elisha Harris.

The subject of town and village Boards of Health was discussed and the views of the attorney general were elicited. Mr. Brooks submitted a communication from ex-District Attorney Rawson, of Richmond county, concerning the necessity for better definitions and distinctions of the jurisdiction and duties of town and village Boards of Health.

A communication was presented from city authorities and physicians of Hudson inviting the Board's attention to the South Bay nuisance of that city. The physicians separately reported as follows: "We, physicians of the City of Hudson, consider that any closing of the present opening in the Hudson River Rail Road embankment crossing the South Bay will be productive of malarial disease and injurious to the health of the citizens, and urge upon the Board of Health to at least maintain our present opening." (*Signed,*) John P. Wheeler, M. D.,

Geo. E. Benson, M. D., Geo. P. Salmon, M. D., A. P. Cook, M. D., C. P. Cook, M. D., F. F. Cochren, M. D., H. Lyle Smith, M. D.

The secretary was directed to reply and to state that the subject had been brought to the attention of the Board.

Communications were submitted from Hon. Dr. M. M. Fenner, chairman of assembly committee on public health, relating to explosive oils and to vivisection. It was

Resolved, That the sanitary committee be directed to report as soon as convenient upon the cause and prevention of accidents from kerosene and similar oils.

Hon. M. Phillips, of Orleans county appeared before the board to ask what action could be taken for abating a nuisance caused by the Erie canal near the village of Holly, in that region of the town of Murray. Malarial fever and its associated evils are attributed to the obstruction of drainage. In reply the Board advised Mr. Phillips that a statement of the case should be made directly by the town authorities, to the State Engineer, and also to the Governor of the State. The Secretary was advised by the president and members to obtain medical facts directly from the physicians in that region. He said that he would do so.

On motion of Mr. Brooks it was

Resolved:—That the State Board of Health shall offer to supply the towns and counties with blank forms for the registry of births, marriages, deaths, burials, at net cost, and that the proper local authorities be notified of this action.

The president submitted communications from citizens of Auburn asking advice upon practical questions of sewerage in that city, and, on his motion, the following resolution was adopted:

WHEREAS, Citizens of Auburn have requested the opinion of the State Board of Health in relation to the proper location for public sewers in that city, therefore

Resolved:—That the secretary of this Board be authorized to express to such citizens and others whom it may concern, that, in the opinion of the State Board of Health, *no public sewer should be constructed beneath private dwellings*, *manufactories*, or *public buildings*, or where avoidable, through private grounds; but in every instance along streets or public throughfares.

Resolved:—That the committee on Registration and Vital Statistics is hereby authorized to have three registers made for immediately commencing the registration of deaths, births and marriages, in the State Bureau of Vital Statistics.

WHEREAS, Small-pox is now prevailing to a dangerous extent in many towns and cities in the State, and

WHEREAS, Except in New York city, the cases of this disease are not published immediately, but intentionally concealed, therefore

Resolved:—That in any amendments which may be made to the law creating this Board, a section should be added making it a misdemeanor for the Health Officer, or Sanitary Superintendent of any city, town or village to neglect to report to the Secretary of this Board any case of small-pox occurring in his district within three days of its coming to his knowledge.

Resolved:—That the law should also provide for requiring the attending physician to report cases to the Health Officer and Sanitary Superintendent. The discussion of the merits of the Pharmacy Bill for the

better regulation of the retail and prescription business in articles used in medicine was taken up, and on motion it was

Resolved:—That in the opinion of the State Board of Health it is very desirable that laws for the regulation of the practice of Pharmacy and the sale of poisons should be adopted for the purpose of protecting the public health from incompetent Pharmacists and from the careless sale of poisons.

Resolved:—That the form of public notice by School Officers, which was adopted by the School Board, district eight, of Amsterdam, Montgomery county, be printed as a sample by this Board to be issued by the secretary to all school districts in the State as illustrating an easy method of securing public attention to the duty of vaccination in accordance with the statute of 1860.*

Resolved:—That in legislation proposed, the Supervisors of the towns of the State be authorized and required to appoint Boards of Health in their respective towns, and that in towns where there are villages the trustees shall make the appointment of the local Board of Health, whose work shall be confined to the territory known as the village. And in cities (except New York and Brooklyn) the Mayor and Common Council shall make the appointments and that in no case shall a member of the Board of Health be selected from the city, county, town or other local officers; and that in each such Board of Health there shall be at least one physician.

Resolved:—That in all Boards of Health it shall be the duty of the Health Board to appoint and define the work and power of the health officer.

Adjourned.

Special Meeting. New York, April 18.

Six members in attendance. Business,—to hear and act upon report of committee on Effluvium Nuisances. Dr. Delavan, chairman of the committee, presented the report.

The report was accepted and adopted. It was

Resolved:—That in the opinion of this Board the report of the special committee upon the stench nuisance complained of in the city of New York clearly establishes the fact that the complaints are well founded, that the odors emanate chiefly from the portions of Kings and Queens counties bordering upon Newtown creek, and that they are caused by carelessness in the management of the business of refining petroleum, discharging the refuse from the oil refineries, the handling of sludge acid, the making of cream of tartar, the manufacture of superphosphate fertilizers by means of sulphuric acid, the rendering of fat, the boiling and burning of bones, the manufacture of ammonia and the transportation and storage of manure.

Resolved:—That in the opinion of the Board the managers of the Empire, Standard and Astral oil refineries, and the owners of the cream of tartar factory, have shown themselves to be commendably active in their efforts to control all sources of nuisance, and with the advice of competent experts have introduced improvements which accomplish

* See [No. 41] in series of Sanitary Papers, p. 121 of this report.

that result; therefore the Board urges upon the Governor the importance of requiring the owners of other oil refineries to adopt the same or other equally effective methods of accomplishing the same results.

Resolved:—That in the opinion of this Board no treatment or utilization of the sludge of the oil refineries should be permitted in the neighborhood of Newtown creek, nor should any portion of it be discharged into the waters of the creek. It should be removed in closed tanks entirely beyond the populous districts, without dilution or needless exposure to the air.

Resolved:—That the manufacture of super-phosphates, from refuse and putrid animal matters, as now conducted, is a source of emanations which should not be endured, nor should such putrid materials be stored or transported in open vessels.

Resolved:—That the improper rendering of fat, and the boiling and burning of bones, and the manufacture of ammonia constitute nuisances of great magnitude, which can be easily abated by the adoption of approved apparatus already in use in many establishments.

Resolved:—That the removal of manure from the large cities and its transportation to the farms where it is finally utilized without annoyance to the residents of the localities where it is produced, or through which it passes, is a problem involving many serious difficulties, but the Board is unanimous in the opinion that it should not be allowed to accumulate in the neighborhood of crowded localities.

On motion it was

Resolved:—That the report and resolutions thereon be recommitted to the special committee with instructions to lay before the Governor the resolutions and such facts connected with the report as may be deemed expedient.

Mr. Brooks submitted the following statement in regard to the Kill-Von-Kull nuisances:

"The attention of the board of health having been called to the unhealthy and unsightly condition of things growing out of the factories on the Kill-Von-Kull — the navigable and much used stream of water which separates the north shore of Staten Island from the opposite shore in the State of New Jersey, — respectfully asks the Governor of the State of New York to communicate to the authorities of New Jersey the following facts:

"1st:—That along the waters on the New Jersey shore — especially on the shore opposite to New Brighton and West New Brighton,— nuisances and offenses emanate from the oil refineries and factories of very serious injury to the comfort of the whole people, on the New York shore, and at times from the effluvium in the air and the contaminations in the water affecting the health of the people. When the wind is in the direction of the island, the offensive odors extend for two or three miles inland, compelling at times the closing of windows and preventing the proper and necessary ventilation of private dwellings.

"2nd:—The water is often covered with oil flowing from the factories into the river and reaching the opposite shore and destroying all pleasure and cleanliness formerly enjoyed from the use of public and private bathing places.

"3rd:—The smell from the gases and sludge coming from the factories is not only personally offensive and especially affecting the sensi-

bilities of sick and nervous people, but the material and contents of buildings all along the shore are discolored from the same cause.

"4th:—The examination and experience of the New York State Board of Health, and of the Boards of Health in the cities of New York and Brooklyn, and elsewhere in and beyond the State of New York, have demonstrated the possibility and the economy of removing or abating all these nuisances. The worst of them composed of sludge should be removed, and all existing nuisances relating to gases, oil and smoke can be abated to the extent of at least ninety per cent, and this without loss to the owners of the property which produces the nuisances. The proper combustion of coal and other fuel, and the proper regulation and control of gases by consumption is the easy, certain and effective remedy for what now results in so much personal discomfort and so much popular indignation.

"5th:—Most of the buildings on the north shore of Staten Island are private residences, occupied by families long residing on the island, and from the causes here named, and for the first time their homes have been made uncomfortable, and in the case of many of their inmates unhealthy, from causes beyond their reach, because wholly under the control of a neighboring State and people. They therefore earnestly and respectfully appeal to the authorities and people to remove this great evil from their midst, and the State Board of Health respectfully asks the Governor of the State to aid the State Board and the people of the village of New Brighton in asking the neighborly interference of the State of New Jersey to remove a public affliction wholly under their control."

On motion it was unanimously

Resolved:—That the statement here submitted by Mr. Brooks be transmitted to the Governor,

The secretary submitted to the Board a petition and papers referred by the Governor to the State Board of Health for examination, from the proprietors of the Oriental Hotel, Manhattan Beach, Coney Island, and suggested that suitable action be taken in reference thereto.

On motion it was

Resolved:—That the special committee on effluvium nuisances be directed to continue its investigation in the direction indicated by the above petition, and report its findings to the annual meeting of the Board in May.

Prof. Waller submitted his report on the chemical nature of effluvia produced by certain manufacturing operations.

On motion it was unanimously

Resolved:—That the committee having charge of the subject lay the report before the Governor with the paper of Prof. Waller incorporated inviting special attention to the expert inquiries that had attended the investigation suggesting the transmission of these documents to the Legislature for publication.

On motion it was

Resolved:—That under the direction which the president shall give to the committee on drainage, sewerage and topography of which he is a member, it shall proceed to take whatever action may be deemed necessary in the following places: Auburn, Geneva, Watkins and the abandoned canal regions, Hudson City, Croton Falls, Cortlandttown and the Yonkers district.

The secretary called attention to the necessity of the State Board

of Health taking action in regard to answering the question now urged upon its attention: Shall it be considered safe for the public health of the localities concerned, and of the State, that the lake-level of Seneca lake should be raised to any height exceeding its mean natural level as marked by the old monuments along the shore?

After discussing the question it was unanimously

Resolved:—That the committee on sanitary drainage, sewerage and topography, through the president and secretary, give such temporary advice as may be in their judgment necessary, based on accurately stated facts, concerning the proposed raising of the level of Seneca lake, as respects the malarial grounds that may be caused by any considerable elevation of that level.

The secretary called attention to the malarial district in the town of Murray, Orleans county, in regard to which Hon. M. A. Phillips, member of assembly from that county, was heard at the last meeting of the Board. He explained his recent visit to the place in company with an assistant engineer of the canal service, and suggested that the president and secretary could safely give the opinion that Mr. Phillips sought, namely — that the swamp between Holley and Hulberton, south of Mr. Cole's property, should be immediately drained.

Adjourned.

ANNUAL MEETING. ALBANY, MAY 10, 1881.

All members in attendance except the attorney-general.

The secretary submitted a statement of the Board's work during the past year and suggested that advantage be taken of the opportunity which Prof. Gardiner would have while in Europe to make observations for the use of this Board in regard to different systems of sewerage construction and sewer outflow in cities and villages.

On motion it was

Resolved:—That in view of the practical importance of drainage and sewerage improvements as illustrated in England and other parts of Europe, Prof. Gardiner is hereby requested and commissioned to make whatever observations and investigations he can concerning this subject during his tour in Europe and to report the results thereof to this board.

Prof. Gardiner was requested by the president to suggest a few names of engineers best known and approved by him to aid the Board during his absence, as occasion may require under the resolution adopted at the last quarterly meeting. Prof. Gardiner named five such civil engineers.

On call of the president the reports of the standing committees were made.

Mr. Brooks also reported that the two houses of the Legislature had inserted in the supply bill an appropriation of twenty thousand for the expenses of the Board for the fiscal year commencing on the first of October next.

The report of the sanitary committee being called for, Prof. Chandler said, that there were two matters requiring investigation which would entail a small expenditure.

1. Water pollution and water supply.
2. Determining upon the instruments and methods for testing petro-

leum. He asked that the sanitary committee be authorized to employ two chemical analysts for the next three months in analyzing samples of water collected from various parts of the State. The sum of four hundred and fifty dollars would be sufficient for the whole work.

On motion it was

Resolved:—That the amount of money appropriated by this Board at the last quarterly meeting for the analysis of waters be and is hereby increased to the total amount of four hundred and fifty dollars, to be expended in maintaining the services of two analytical chemists for three months of the present summer.

Resolved:—That the chairman of the sanitary committee is hereby requested to prepare the necessary instructions and schedule of questions to be used in the selecting of samples of water for analysis to be issued by the president and secretary, with the Board's request for a statement for suspecting the purity of the waters.

Resolved:—That the sanitary committee be authorized to spend a sum not exceeding one hundred and fifty dollars, in prosecuting the investigations preparatory to testing petroleum in establishing a standard for such test in this State.

The secretary called attention to the wide diffusion of small-pox in the different towns of the State and the responsibility of the Board in relation thereto and suggested the importance of rules for personal quarantine and domestic regulations applicable the State over.

The president suggested that there should be an instructive memorandum prepared and supplied to the local sanitary authorities, pointing out the best mode of procedure for abatement of nuisances and the execution of sanitary rules and regulations. A convenient four page manual illustrating what to do in a case of small-pox or other contagion, the rights, duties and the mode of procedure of the local officers in respect thereto, would be most desirable.

Resolved:—That the committee on quarantine and the sanitary committee jointly with the president and secretary of the Board to prepare a brief circular adapted to aid local authorities and families in the duties of domestic and internal quarantine.

The president requested the secretary to put in form such a memorandum or circular as shall best combine this resolution and the suggestions he had made concerning sanitary procedure against nuisances, etc.

The secretary called attention to the data in his possession concerning the crowded condition of school houses. He asked if some action should not be taken by the Board.

On motion it was

Resolved:—That the committee on public institutions prepare a circular to be addressed where and to whom necessary upon the subject of air-space, ventilation and lighting of school rooms.

The report of the committee on effluvium nuisances being called for, the chairman reported progress in the investigations at Manhattan Beach and on Barren Island.

The secretary referred to the importance of the State Board issuing a weekly or monthly statement of mortality and the prevailing diseases.

Annual Election:—In accordance with the requirement of section 3, of chaptei 322 of 1881, the Board now proceeded to its annual election of president and the appointment of standing committees. On motion

the secretary was instructed to deposit one ballot for the president of the Board during the ensuing year, and that the ballot bear the name of Dr. E. M. Moore.

The president re-appointed the committees of last year to serve during the present year, adding the name of Commissioner Brooks to the committee on drainage, sewerage and topography.

Adjourned.

SPECIAL MEETING. ALBANY, JUNE 23.

Seven members in attendance.

The consideration of the food and drug, entitled chapter 407, laws of 1881, was taken up and the act was read through.

The duties imposed upon the Board by this law and the best means for carrying out its provisions occupied much of the time of the meeting. After discussion it was on motion,

Resolved:—That the secretary be authorized to print 1,000 copies of chapter 407, of the laws of 1881, for the use of the Board.

Resolved:—That the secretary be directed to prepare and print a circular calling attention to the provisions of chapter 407 of the laws of 1881, and inviting information and suggestions to promote the objects of this law.

After further conference in regard to the subdivision of the work among chemical experts, and the classification of the substances to be analyzed; it was on motion.

Resolved:—That the State Board of Health engage the services of competent persons to investigate the subject of existing adulterations in the articles of food and drugs and their compounds, and to inform this Board as soon as possible of the extent to which these articles are adulterated together with the best methods for the detection of the adulterations.

The various chemical experts available for this work in the State of New York and the inexpediency of going outside of the State for such help were considered.

On motion it was

Resolved:—That the following chemists be appointed in accordance with the last resolution, and that the sum of four hundred dollars be paid to each for his services when rendered:

Prof. S. A. Lattimore, Ph. D., LL. D., Rochester University; Prof. A. H. Chester, A. M., Hamilton College, Clinton; Prof. G. C. Cadwell, Ph. D., Cornell University, Ithaca; F. E. Englehardt, Ph. D., Onondaga Salt Company, Syracuse; W. H. Pitt, M. D., Buffalo; J. C. Draper, Ph. D., New York; F. Hoffmann, Ph. D., New York; E. G. Love, Ph. D., New York.

The assignments and details of this work were discussed.

On motion it was

Resolved:—That the supervision of these investigations be referred to the sanitary committee with power to arrange the details and distribute the work among the chemists and analysts employed, and to report progress made in the organization and work at the August meeting of the Board.

The question of employing inspectors to collect samples accused or

suspected of adulteration was considered. After discussion it was on motion

Resolved:—That the sanitary committee be authorized to make such arrangemenrs as seem best for the collection of samples and the forwarding of the same to the chemical analysts for examination, at a total expense not to exceed four hundred dollars.

Resolved:—That the sanitary committee is hereby authorized to convene the analysts and inspectors for a conference at a time and place to be named by said committee, and that their necessary traveling expenses be defrayed by this Board from the fund appropriated for said bureau of chemical analysis.

The health officer asked the Board's attention to the widespread prevalence of small-pox in all of the ports and in most of the cities of Europe.

Several months ago he issued a circular letter to all owners and masters of emigrant ships, urging that all necessary sanitary regulations at the ports of departure to prevent the presence of small-pox among emigrants, should be enforced. He submitted the following:

WHEREAS, It is believed that small-pox is at the present prevailing as an epidemic in some of the ports of the British Islands and of continental Europe, and

WHEREAS, The emigration from those countries to the United States, principally through the port of New York, is at this time unprecedented, and as we recognize the fact that the incubative period of the disease is greater than that of the average passage of steamships from the ports here mentioned to ports in the United States, thus affording an opportunity for emigrants infected at the port of departure to pass our quarantine and reach interior communities before the development of the disease, therefore

Resolved:—That this Board request the National Board of Health as a necessary measure of inter-State quarantine, to appoint an inspector of emigrant trains at Buffalo and Suspension Bridge, whose duty it shall be to examine all emigrants arriving at those places.

Resolved:—That this Board respectfully recommends that the National Board of Health shall provide for such inspections at Chicago, Pittsburgh, St. Louis and Omaha, and such other points as it may deem proper, during the prevalence of small-pox as an epidemic at the ports from which emigrants embark.

The preamble and resolutions were adopted.

The president introduced the subject of miasmatic diseases, caused by the stagnant water in the Genesee Valley canal, within the limits of the city of Rochester, and suggested the propriety of the Board registering its opinion upon that point.

The secretary called attention to drainage works provided for by law along sections of the late Chemung and Genesee Valley canals, and explained the result of his observations there during the previous week, and what was needed to be done to insure satisfactory results.

The president confirmed the views expressed and suggested that inasmuch as the Board was in a measure responsible for the successful execution of the projected work, some recommendation would be necessary.

On motion it was

Resolved:—That the Board's supervision of the Chemung and Genesee

Valley canal drainage be referred to the committee on drainage, sewerage and topography, with power to engage the services of such physicians and such engineer to aid in the work as may be.

Resolved:—That this Board furnish suitable blanks, or a form of same, to be sent to the different local Boards of Health, that the health officer may make a report as required by law, of all acute and contagious diseases recognized by the health authorities of the State.

The secretary offered the following list, and promised that the schedule should be prepared and submitted to, and approved by the committee on registration and vital statistics before printing.

Malignant cholera, yellow fever, typhus fever, typhoid fever, relapsing fever, scarlet fever, puerperal fever, cerebro-spinal fever, small-pox, diphtheria, dysentery, measles.

The secretary presented a petition from citizens of New Rochelle and reported the action thereon, and also presented the resolutions adopted by the committee on effluvium nuisances on the 3rd of June, showing the policy that had been adopted, in dealing with such complaints. The course was approved.

The president called attention to the duty of the Board's issuing a notice to all towns and villages in regard to the duty of organizing their local Boards of Health.

Adjourned.

Quarterly Meeting, August 10 and 11.

Held at Niagara Falls.

Seven members in attendance, viz.: Drs. Moore, Delavan, Hunt, Smith, Harris, and Mr. Brooks.

The minutes of annual meeting were read and approved. Standing committees presented reports. The chairman of the sanitary committee reported, " that a meeting of the chemists appointed by the Board under chapter 407 of 1881, was held in New York July 6th, and the organization of the bureau of chemical analysts effected. He presented the printed minutes of that meeting. [See these minutes in report on chemical examination of food and drugs.] He also reported on the progress of analysis of potable water supplies, by Prof. Waller, also on Prof. Elliott's investigations of safety-tests for petroleum illuminators.

The health officer (of quarantine) reported for the committee on internal and external quarantine on the dangers to be apprehended from foreign immigration, in the introduction and dissemination of small-pox and the necessity for federal and international measures to avert the evil.

The report was accepted and ordered to be given to the press for publication.

The secretary reports the state of work in removing nuisances along the line of the abandoned canal between Havana and Horseheads; also on the line of the late Genesee Valley canal in the towns of York, Leicester, Mt. Morris, and West Sparta. He also reported progress in the investigations and counsels at Hudson city, also an inspection by the committee and its sanitary engineer at a crowded summer hotel in

Richmond county, and at New Rochelle to investigate a nuisance caused by the drainage of a large brewery.

On motion of Mr. Brooks it was

Resolved:—That the thanks of the members of the State Board of Health are hereby offered to its president, Dr. Edward M. Moore, for the able, impartial and very satisfactory manner in which he has presided over the meetings of the Board during the first year of its existence.

Dr. Delavan, from the committee on effluvium nuisances reported the inspection of two super-phosphate factories on Barren island, where extensive ponds of sludge were exposed in the open air.

After some discussion in regard to the present powers of the committee on effluvium nuisances it was

Resolved:—That the special committee on stench nuisances be directed to request the Governor to close at once the factories on Barren island which disseminate odors of sludge acid, to the discomfort of the summer resort, and to furnish the Governor the names of the said factories and of the firms operating them.

Resolved:—That the special committee on stench nuisances be directed to request the Governor to close at once all refineries and other establishments at and near Newtown creek that permit sludge acid, tar, or any other refuse to run into the creek, or on the neighboring grounds, or allow offensive odors to escape from the same, until such time as in the opinion of the committee such improvements shall have been made in the factories, as will in future prevent such offensive discharges and odors.

Resolved:—That the committee on stench nuisances be directed to furnish the Governor the names of said factories, and of the firms operating same.

On motion it was

Resolved:—That the committee is empowered to recommend to the Governor the entire supervision and closure of any factory or establishment in the vicinity of Newtown creek, from which a stench nuisance emanates to New York or Brooklyn, whether from sludge acid or other causes.

Dr. Hunt, as commissioner, and as the health officer of Utica, called attention to a nuisance in the town of Deerfield north of the Mohawk, opposite Utica, and near the New York Central railroad depot; consisting of a slaughter-house, where from putrid offal a very offensive stench arises. He had vainly called upon the local Board to abate it. He wished the aid of the State Board toward securing its abatement. On his motion it was

Resolved:—That the State Board of Health call the attention of the health authorities of the town of Deerfield to the nuisances arising from slaughter-houses and other establishments near the bank of the Mohawk river opposite the city of Utica, and request that they cause the same to be abated.

Dr. Hunt also called the attention to a nuisance caused by an outfall sewer that receives the filth of the fifth, seventh, and ninth wards, and discharges it into a ravine running through the eastern part of the city thence into the Erie canal. Much sickness, he claimed, is caused by this nuisance. The city should be compelled to conduct a sewer through the ravine, and culvert it under the Erie canal. After consideration it was, on motion

Resolved:—That in the judgment of this Board upon the facts here submitted the discharging of sewage, or other filth into the Erie canal from the eastern part of the city of Utica, and likewise the discharge of sewage into the abandoned Chenango canal, is an evil which should be prohibited and prevented, as a cause of injury to the public health.

Resolved:—That the State engineer and superintendent of public works respectively be furnished with a copy of this resolution.

The health officer of Buffalo and other citizens of that city, appeared before the Board and reported upon the Hamburgh street and Erie canal nuisances of their city.

The health officer and citizens of Lockport appeared in person to report the evils suffered in their city from the stench nuisance arising from the Erie canal as it passes through that city. They showed that the people of Lockport were sufferers from the sewage of Buffalo, which was poured into the Hamburgh canal. The public water supply for general purposes, domestic uses alone excepted, is derived from the canal by means of the Holly system.

The secretary submitted papers and affidavits from Hartland, Niagara county, in reference to a source of nuisance from swamp lands, alleged to be caused by overflows and spills-ways of the Erie canal, and in reference to which an appeal to the State Board had been made. Mr. Chase the supervisor of Hartland, was present to explain this matter. Mr. Chase said that he attributed the nuisance to the enlargement of the Erie canal which caused a greater overflow of water into the eighteen mile creek than its size would admit without flooding the adjacent lands, thus creating swampy and marshy grounds, which had been the occasion of much miasmatic disease. There was in his opinion but one practicable plan for remedying the evil; namely by draining the creek and enlarging its bed.

The secretary reported that the drainage works along the bed of the abandoned canal in Chemung and Schuyler counties were completed in a little more than one month (ending August 9th).

The urgent necessity for some twenty miles of drainage in and near the bed of the late Genesee Valley canal, and the conflicting proprietary interests involved was discussed, and on motion it was

Resolved:—That the Governor be informed by the committee on drainage, sewerage, and topography, of the situation of affairs in the malarial neighborhoods along the line of the late abandoned canal in the Genesee Valley; and also informed of what sections need to be immediately drained and secured against the artificial swamps in the bed of the old Genesee Valley canal, which cannot (under existing laws) be provided for under chapter 593.

The secretary next submitted petitions from citizens of Schenectady, referred by the Governor to the Board, with letters pertaining thereto, appealing for relief from nuisances caused by imperfect sewage in Cowhorn, College, and Mill creeks, in that city. He said the drainage committee had visited the place in company with two professors of engineering, and another expert engineer, who made a report thereon. The people were responsible for this condition of things. The committee was ready to report its conclusions to the Governor, as it had already communicated with the Mayor and Board of Health of Schenectady. After consideration it was, on motion,

Resolved:—That a copy of the report of the committee, as forwarded

to the Mayor and Board of Health of Schenectady, be sent to the Governor, and that the Governor be further informed that, in the judgment of this Board, it is the duty of the people of Schenectady to proceed at once to the abatement and prevention of this nuisance.

The Board of Health of Spencerport submitted a petition from residents of that village in regard to the condition of the pond and adjacent swamp lands within village limits. It was one of many nuisances with which the Board would have to deal promptly.

The secretary also called attention to the petitions from Piffardinia, Livingston county, and to the need for engineering service there, and southward, in the towns of York and Leicester. On motion, it was

Resolved:—That Mr. Kuichling, civil engineer, be requested to visit York and Leicester, to give some immediate advice to the local Boards of Health, with a view to the removal of the causes of malaria, concerning which they had appealed to the State Board.

The duty of local authorities acting for themselves upon their own orders in regard to the removal of nuisances was discussed.

On motion, it was

Resolved:—That the secretary of the Board be directed in all cases of complaint of bad drainage, sewage, ventilation, or sickness, caused by the neglect of the local authorities and people, to provide for the health of their own citizens, to inform the local Boards of Health, trustees, supervisors, town clerks, and other officers, that the first duty of cities, villages, and towns, is to adopt measures for their own comfort and safety, and that the State Board of Health, thereon, will offer all the aid and support which it is permitted to give under the laws of the State.

The prevalence of malaria and the importance of collecting information on the subject was discussed.

On motion it was

Resolved:—That the committee on registration and vital statistics be directed to prepare a series of questions with regard to the prevalence of malaria to be sent to the local Boards of Health.

Resolved:—That an additional sum of $150 be appropriated to complete the investigation of apparatus for most accurately determining the safety standard flash-test of petroleum.

Resolved:—That the sum of $400, or so much as may be necessary, be added to cover the expenses of inspection in the collection of samples, in carrying out the provisions of chapter 407, laws of 1881.

Resolved:—That the secretary be authorized to print for the use of the Board, the prepared list of authorities on the adulteration of food and drugs.

The secretary presented a special statement and report on systematic vaccination, and the Board's duty in regard to it, as yesterday requested by the president of the Board. [See the report in the appendix.]

After discussion it was

Resolved:—That this Board recommends the establishment by the State of a "Vaccine Farm," under the supervision of the State Board of Health, for the production and maintenance of pure vaccine virus, for gratuitous distribution to all local health authorities, public institutions and schools in this State, and that such action as will be necessary to secure this result be referred to the sanitary committee, the committee on external and internal quarantine, and the committee on registration and vital statistics.

Prof. Stephen Smith, the Board's delegate to the Chicago Inter-State conference, on the subject of small-pox and quarantine, held July 30, made his report. He explained the objects and results of the conference, and presented a copy of the resolutions there adopted to prevent the introduction of small-pox, and its spread throughout the country by means of immigration.

On motion it was

Resolved:—That the thanks of this Board be tendered to Professor Stephen Smith, for his able representation of the New York State Board of Health at the Inter-State sanitary conference at Chicago.

Further discussion on the need for repressive measures to prevent the introduction and dissemination of small-pox ensued.

On motion it was

Resolved: — That the New York State Board of Health will co-operate to the full extent of its power with the National, State and local authorities for the prevention of the introduction of small-pox into this country by immigration ; its spread from one State to another ; and its extinction wherever it exists in the State — through a systematic plan of general vaccination.

Resolved:—That in view of the epidemic form of small-pox in many ports and countries in Continental Europe, Canada and the British Isles, the National Board of Health is respectfully requested to secure the vaccination of all unprotected immigrants, within twenty-four hours after leaving the port of departure, and a prompt vaccination or re-vaccination, at the port of arrival, of all persons not thus protected against small-pox.

The subject of the sanitary condition and needs of school-houses which had been entrusted to the standing committee on public institutions at the last quarterly meeting, and the preparation of a circular ordered, being brought forward it was

Resolved:—That the committee on public institutions be authorized to use its discretion in obtaining such architectural counsel as may be necessary in preparing its report for use in the second annual report of the Board, at a cost not to exceed two hundred dollars.

Mr. Brooks called attention to the propriety of the Board giving expression to its sentiments concerning the assassination of the President, at this, its first meeting since that terrible crime. On his motion, seconded by Dr. Delavan, the following preamble and resolutions were unanimously adopted:

WHEREAS, The State Board of Health, of New York, in sincere sympathy with the President of the United States, in his prolonged sufferings, has heard, with great satisfaction, of the daily improvement in his condition, therefore,

Resolved: That holding in utter abhorrence the crime committed against the President, and the motive of this crime, it becomes the duty of every citizen who would maintain the permanence and integrity of the government to discountenance all like offenses, and to secure, as far as possible, the just punishment of all violations of law, whether committed against persons in official places, or against the institutions of the country necessary for its preservation,

Resolved:—That a copy of this preamble and resolutions be sent to the President under the official seal of the Board.

Adjourned.

Last Quarterly Meeting in 1881.

Albany, *November* 9.

Present—Dr. E. M. Moore, *President*, Erastus Brooks, Dr. J. Savage Delavan, Dr Wm. M. Smith, Dr. James G Hunt, and Dr. E. Harris, *Secretary*.

The reports of the standing committees were presented as follows: The executive and finance committee reported that on the first of October a small balance was remaining from the first appropriation, the total amount expended, in sixteen months, being a little over $14,000, and that in November the new appropriation began to be drawn upon.

The chairman of the committee submitted a statement of appropriations needed for the support of the Board's work during the fiscal year commencing October 1st, 1882.

The sanitary committee submitted a report from A. H. Elliott, Ph. D., on the safety-test of petroleum illuminators, and suggested that the report be returned to him for completion before December 15th.

Resolved, That the Board hold a special meeting on Friday, December 9th, at its central office, Albany, to consider the various contributions appended to the annual report.

The sanitary committee submitted a copy of the printed regulations adopted by the health department of the city of New York, relating to domestic drainage and plumbing, and asked that with Prof. Gardiner's approval the State Board should adopt and promulgate the same.

It was

Resolved:—That the regulations adopted by the health department of the city of New York relating to domestic drainage and plumbing be referred to the standing committee on drainage, sewerage and topography with power to revise and prepare additions or amendments of such revised pamphlet to be submitted to the Board.

The committee on vital statistics reported progress made.

The chairman of the committee on public institutions, said he was not prepared to make a final report.

A report of the committee on drainage, sewerage and topography was presented.

The president reported the results of his investigation of the Eighteen-mile creek in Hartland. He submitted a series of affidavits bearing on the subject. He found the medical men of the district do not sustain the position taken by the petitioners.

The committee on effluvium nuisances submitted a report on the present aspect of the nuisances at Hunter's Point.

On motion it was

Resolved:—That the special committee on effluvium nuisances be requested to prepare a complete report of its labors to be incorporated in the annual report.

The health officer, Dr. Smith, called attention to the evidence that tanks of the sludge, or spent acid, had been dumped at and near the Narrows, or that the stuff had floated around there from Jersey side, creating an intolerable nuisance to inhabitants on the shores of the bay On his motion it was

Resolved:—That the committee continue its work as a committee of observation, with power to employ inspectors for such localities as have been, or may be, employed in the commission of such nuisances.

On motion it was

Resolved:—That the State Board of Health of the State of New York, again make an earnest request to the Board of Health of the State of New Jersey for the removal of the nuisances growing out of the manufactories on the Kill-Von-Kull opposite to the shores of Staten Island, producing, as they do, most offensive smoke and smells, and at times, the flowing of sludge into the waters which separate Staten Island from the State of New Jersey.

Resolved:— That the committee on effluvium nuisances be the special committee to wait upon the Governor and Board of Health of the State of New Jersey to represent the condition of things as affecting the inhabitants and waters of the bay.

Resolved:—That the services of Dr. Lincoln be retained until the first of January at the same rate of compensation as he has received.

Inspector Colby submitted a package of coffee mixture which he had found being sold in open market under the name " of Board of Health Coffee. "

On motion it was

Resolved:—That the secrctary be requested to notify the manufacturers of " Wright, Gillies and Brothers," " Board of Health Coffee," of the offensive and unauthorized use of the name on their " coffee packages."

The secretary called attention to the former action of the Board in reference to the establishment of a vaccine farm and the many calls that had been made for virus from local Boards of Health, the payment for which the State Board had guaranteed to the various persons who supplied. After further discussion it was

Resolved:—That the subject of a vaccine farm be recommitted to the three committees already named with power to prepare a bill to be submitted to the Legislature.

Attention was called to the petition from New Rochelle under investigation by the Board and the progress made therein. On motion it was

Resolved:—That the committee on drainage, sewerage and topography be hereby directed to make a report as soon as practicable on the removal and prevention of the nuisances complained of at New Rochelle which was referred to this Board by the Governor, and that the committee be authorized to employ an engineering expert to examine and report upon said nuisance.

The secretary called attention to numerous complaints and petitions in regard to swamps along the line of the Erie canal and the necessity for some report being made upon them immediately, The absence of Prof. Gardiner, chairman of the committee, in Europe, had been the chief cause of delay.

After consideration it was

Resolved:—That the various papers referred by the Governor to the Board be immediately submitted to the committee on drainage, sewerage and topography with instructions to make all necessary investigations and report directly to the Governor.

The following resolution was submitted and adopted:

Resolved:—That the president, Dr. Edward M. Moore, be authorized to represent the Board at the meeting of the American Public Health Association to be held at Savannah on the 29th of November.

Also on motion it was

Resolved:—That Hon Erastus Brooks be added to the delegation

from this Board to the meeting of the American Public Health Association.

Resolved:—That Dr. Chandler be authorized to retain the services of only those inspectors that he needs, at the same rate of compensation as heretofore paid, until the next meeting of the Board.

The subject of the preparation of a bill to prevent injury to life from explosive illuminators was considered, and it was

Resolved:—That the sanitary committee and the committee on laws prepare the draft of a suitable law to be enacted for the prevention of injuries from explosive illuminating oils.

Adjourned.

Abstract of Transactions Relating to Small-pox.

[*Supplementary to minutes.*]

As numerous records of work during the past year need to be presented in abstract in connection with the foregoing transcript of minutes, the following epitome is submitted:

Procedures for the suppression of small-pox in Washington county in December and January.—December 25, 1880, the petition of inhabitants of the hamlet of Shushan, in Salem, required a prompt decision in support of the quarantine that was being enforced by the Salem Board of Health. The health officer was urged to unite all the physicians of the town in the duty of vaccinating from house to house, as well as among their own patrons, and to aid this the State Board guaranteed the payment of certain quantities of fresh vaccine virus. The quarantine requirements were not relaxed until the whole population had been protected.

Small-pox in Fremont, Sullivan county.—On the 30th of January notice was received from the town clerk of Fremont, the south-western town in Sullivan county, that small-pox was spreading in a certain school district of that town, and in answer to his appeal for advice and assistance for the arrest of the contagion, the secretary ordered supplies of fresh bovine virus to be sent to them. The disease subsided after about six weeks.

Small-pox at Amsterdam.—The attendance at the public school was ordered suspended late in the month of December, until the order of the vaccination should have been complied with, and the result was, happily, as shown by Mr. McClumpha's letter, the latter order had been fully complied with before the second of January, so that the school was opened on the first Monday of the new year.

Small-pox in Broadalbin.—On the 17th of February, Dr. Thorne, health officer, communicated information concerning cases of small-pox in that town, resulting from exposure in Amsterdam. The chief points in this case were that a case of varioloid, contracted from exposure to one of the Guibord cases, late in autumn, was closely quarantined, and immediately upon determining the diagnosis, vaccination was extended to all the exposed population in that town. Only one other case occurred from the exposure that had already been suffered.

Small-pox in Johnstown.—During March and April small-pox appeared among the paupers in the town, and having begun to spread in the poor-

house of the county, Dr. Beach was appointed physician. At once a barracks, or hut hospital was constructed, and complete separation of the sick from all other persons secured. Vaccination was offered by public notice to each of the schools in the town, including the villages of Gloversville and Johnstown. In the latter village the school board issued notice, according to law, appointing Dr. Wm. L. Johnson to see that the law regarding vaccination of school children was thoroughly carried into effect. Small-pox ceased entirely after a few weeks. In these Fulton county cases the State Board was consulted and its advice strictly followed.

Small-pox at Glens Falls.—On the 9th of August 1881, the secretary received information that small-pox was prevailing in a virulent way at Glens Falls. He immediately advised the Board of Health and health officer of that village, and of the town of Queensbury in which the town is situated, to enforce strict domestic quarantine and the public offering of vaccination and revaccination to all the inhabitants. On returning from the western counties the secretary was met by an urgent request to confer with the Board of Health of Queensbury and of Glens Falls, and on the 16th he made such visit. Great alarm then prevailed throughout the town of Queensbury and in the surrounding towns, and as the town Board of Health then offered to provide hospitals and attendants a mile beyond village limits, the village health officer was appointed health officer of the town, and free vaccination was offered to all classes of inhabitants in the village and town alike. Hospitals were constructed of boards and ready-made doors and windows, on a lofty, sandy plain nearly two miles west of the railway depot, half a mile from habitations, near a good well of water. Competent nurses and medical attendants were provided immediately, and all suitable places were at once occupied under orders of the village Board of Health. The first orders were resisted by wordy threats of violence against the health officers. These were harmless, however, and the health officer's orders were implicitly complied with. There were fifteen dwellings under quarantine at the hour the secretary left Glens Falls.

After a few days the capacity of the hospital as first outfitted proved insufficient, and a new one, fully equipped and well appointed, was constructed in a single night and occupied next morning. After a few days another of still better appearance and equipment was constructed in another night and occupied next morning by a worthy citizen who survived and has paid the cost of building ($65).

Another hospital building was erected in a single day, but as the disease subsided under the control of vaccination, the last-named building was never occupied.

Small-pox in Argyle.—While small-pox was at its height in Glens Falls, a laborer, aged 23 years, came home to his brother-in-law, near the town line of Fort Edward, and was taken to his mother's, a mile from Argyle village, with virulent small-pox. Immediately the town Board of Health organized under advice of the State Board of Health under chapter 431, of 1881.

The health officer, Dr. M. L. McNeil, vaccinated and revaccinated the entire family of the small-pox patient within a few hours after his arrival home and with the result of entire protection of them all. In the course of a few days 650 persons were gratuitously vaccinated, and many more paid for their vaccination with the result that in a pop-

ulation of 2,700 not a case of small-pox had occurred excepting the one patient who died. The entire school population was reported as being well vaccinated at the time of the visit of Commissioner Brooks and the secretary on October 14, 1881.

Vaccination at Fort Edward.—As at Argyle and numerous other places that maintained almost hourly intercourse at that period with Glens Falls as a trade town, notice was given by the secretary of the Board, during the month of August, and the utmost activity in vaccination was secured. The first warning was given August sixteenth, the day of the first inspection at Glens Falls. Dr. Farley, health officer, and Rev. Dr. King, principal of the Fort Edward Institute, were urged to have vaccination complete within a week from that date. It has been ascertained since that those gentlemen and the town Board of Health, which was immediately organized, urged on this step until it was very nearly completed within a fortnight from that time. Fort Edward is six and a half miles from Glens Falls, and has hourly communication by rail and highways with the village of Glens Falls. Not a case of small-pox occurred in the village or township, and at the time of the conference with the Board of Health and Rev. Dr. King October fourteenth, Commissioner Brooks and the secretary found public opinion was conclusive that the entire population had been protected by their timely vaccination and revaccination.

Sandy Hill vaccination.—The village of Sandy Hill is but three miles from Glens Falls, and has hourly communication, day and night, with the latter. During the last half of the month of August, the Board of Health of that village became thoroughly organized and was supplied with fresh vaccine virus ordered under guarantee of the State Board of Health. One thousand two hundred and fifty points were used gratuitously by the health authorities and much more by private practitioners, scarcely any inhabitant remained unvaccinated. School children are reported to be completely protected. The secretary of the Board of Health had an interview with Commissioner Brooks and the secretary of the State Board on the fourteenth, and assured them that the entire town is well protected, and he exhibited a bill for one hundred and thirteen dollars for vaccine virus yet unpaid for, but guaranteed by the State Board of Health. He volunteered the assurance that the town Board or village Board upon meeting would order the bill paid.

REPORTS OF COMMITTEES OF THE BOARD.

Report of Executive and Finance Committee.

Statement of expenditures under chapter 322, of 1880, and chapter 431, of 1881, from May 29, 1880, to September 30, 1881, including all expenditures embodied in the first annual report.

Printing and Stationery.

1880.	July 12.	E. Bender & Son, for blank books	$16 00
	17.	Samuel Raynor & Co., envelopes	76 75
	28.	Weed, Parsons & Co., printing	93 50
	Aug. 2.	J. J. Little, printing and electrotype plates	372 33
	10.	F. S. Hasbrook, stationery	12 35
	10.	Argus Company, printing	110 75
	Sep. 30.	Comptroller, bill of stationery	137 28
	30.	J. J. Little & Co	27 00
	Oct. 30.	J. J. Little & Co., printing	24 50
	Nov. 5.	E. Bender, stationery	7 75
	9.	S. Raynor & Co., stationery	9 00
	13.	Argus Company, printing	366 50
	18.	R. K. Quayle, printing	13 00
1881.	Mar. 1.	S. Raynor & Co., stationery	27 91
	20.	E. H. Bender, stationery	7 20
	May 14.	J. J. Little, printing	36 10
	21.	Weed, Parsons, printing	141 05
	25.	C. Van Benthuysen, printing	132 65
	July 22.	F. S. Hasbrook, stationery, letter books, etc.	15 30
	Aug. 29.	Comptroller, bill of stationery	157 25
	Sep. 30.	Weed, Parsons & Co., account	85 75
			$1,869 92

Postage, Expressage and Telegraphing.

1880.	June 24.	Postage stamps	$170 00
	July 8.	Postal cards	20 00

1880.	Oct. 18.	Postage stamps	$31 00
	Nov. 23.	do	35 00
1881.	Jan. 18.	do	88 00
	Feb. 17.	Telegraph company	11 75
	Mar. 8.	Postage stamps	100 00
	April 29.	do	40 00
	June 18.	do	42 00
	July 29.	do	80 00
	Aug. 4.	Expressage	9 05
	do	Postage stamps	75 00
	Sept. 17.	do	40 00
			$741 80

Salaries and Wages.

1880.	June 29.	Dr. Harris, secretary, salary from May 29th to June 30th	$274 00
	July 31.	Robert Nelson, salary as clerk from June 23d to August 1st	103 22
	Aug. 2.	Dr. Elisha Harris, secretary, salary for July..	250 00
	Sept. 1.	do do August.	250 00
	1.	Robert Nelson, salary as clerk for August ...	80 00
	Oct. 1.	Dr. Elisha Harris, secretary, salary for September	250 00
	1.	Robert Nelson, salary as clerk for September.	80 00
	30.	Dr. Elisha Harris, secretary, salary for October	250 00
	30.	Robert Nelson, salary as clerk for October..	80 00
	Nov. 24.	Dr. Elisha Harris, secretary, salary for November	250 00
	Dec. 2.	Robert Nelson, salary as clerk for November.	80 00
	Jan. 3.	Dr. Elisha Harris, secretary, salary for December	250 00
	do	Robert Nelson, salary as clerk for December.	80 00
	do	Robert Nelson, for night work	16 00
	Feb. 1.	Dr. Elisha Harris, secretary, salary for January	250 00
	do	Robert Nelson, salary as clerk for January...	100 00
	18.	Louis W. Pratt, for clerical services........	60 00
	Mar. 2.	Dr. Elisha Harris, secretary, salary for February	250 00
		Robert Nelson, salary as clerk for February..	100 00
	Mar. 31.	Dr. Elisha Harris, secretary, salary, March..	250 00
		Robert Nelson, salary as clerk for March....	100 00
	May 2.	Dr. Elisha Harris, secretary, salary for April.	250 00
		Robert Nelson, salary as clerk for April	100 00
	June 1.	Dr. Elisha Harris, secretary, salary for May..	250 00
		Robert Nelson, salary as clerk for May......	100 00
	July 1.	Dr. Elisha Harris, secretary, salary for June.	250 00
		Robert Nelson, salary as clerk for June.....	100 00
	Aug. 8.	Dr. Elisha Harris, secretary, salary July.....	250 00
		Frederick Carman, stenographer and clerk, salary for July........................	150 00

1880. Aug.	8.	Robert Nelson, salary as clerk for July......	$100 00
Sept.	1.	Dr. Elisha Harris, secretary, salary for August.	250 00
	1.	Frederick Carman, stenographer and clerk, salary for August	150 00
	1.	Robert Nelson, salary as clerk for August...	100 00
	1.	Fergus Halpen, office messenger, salary August	12 25
	30.	Dr. Elisha Harris, secretary, salary for September.................	250 00
	30.	Frederick Carman, stenographer and clerk, salary for September...................	150 00
	30.	Robert Nelson, salary as clerk for September	100 00
	30.	Fergus Halpen, office messenger, salary for September............................	15 16
	30.	John Kerr, wages for services in Hunters Point, etc...........................	145 45
			$6,126 08

Expert Services.

1880. Sept.	25.	William Packer Prentice, preparation of Manual of Public Health Laws...........	$500 00
	25.	John C. Collins, clerical and expert services on Manual and as stenographer..........	75 00
	25.	Julius W. Adams, civil engineer............	150 00
Dec.	8.	Frederick Carman, stenographic and clerical services..............................	49 00
1881. Feb.	17.	Frederick Carman, stenographic and clerical services..............................	7 00
	28.	Frederick Carman, stenographic and clerical services..................	73 50
Mar.	5.	Frederick Carman, stenographic and clerical services..............................	77 00
	17.	Col. G. E. Waring, Jr., services as sanitary engineer................................	177 77
	31.	Frederick Carman, stenographic and clerical services..............................	133 00
April	30.	Frederick Carman, stenographic and clerical services	175 00
		W. Ellery Davis, stenographic service.......	5 00
May	27.	Prof. A. Liantard, veterinary expert.........	10 90
June	1.	Frederick Carman, stenographic services, etc.	168 00
	14.	W. S. Egerton, civil engineer..............	22 05
July	7.	Frederick Carman, stenographic and clerical services	150 00
Aug.	4.	Emil Kuichling, C. E......................	50 53
	4.	Thomas Nealis, sanitary engineer...........	10 00
	31.	J. J. R. Croes, C. E......................	55 25
Sept.	2.	Emil Kuichling, C. E...	61 73
	5.	Egbert Bagg, C. E..........	14 12
	6.	Elwyn Waller, Ph. D., for water analysis.....	161 95
	12.	A. H. Elliot, for petroleum testing and investigations	155 00

1881. Sept. 16.	P. Hogan, civil engineer....................	$49	90
	Elwyn Waller, Ph. D., for report on sludge..	50	00
	Albert L. Colby, Ph. B., " " ..	20	46
	W. S. Egerton C. E........................	27	85
		$2,430	01

Library, Books, Maps and Charts.

1881. May 14.	W. C. Little, for books	$65	50
June 18.	Dr. Harris, for sundry purchases	31	15
		$96	65

Furniture.

1880. July 17.	Press and stand...........................	$22	95
21.	F. S. Hasbrook, furniture..................	57	59
Aug. 3.	Seal and seal press........................	30	00
16.	Plate note heading.........................	30	00
Nov. 10.	2 ash tripods for maps	7	00
1881. June 24.	Oak registry cabinet and table	60	00
July 16.	Whitney & Co., matting and office goods....	28	35
22.	Matting	12	13
		$248	02

Investigation of Disease.

1881. Feb. 17.	Various expenses incurred while investigating diseases in various places in September, October and November, 1880, per account.	$274	64

Traveling and other Necessary Expenses of Members of the Board while on Duty.

1880. July 13.	Dr. E. M. Moore, expenses	....	$49	74
17.	Dr. J. S. Delavan,	do	30	59
Aug. 2.	Dr. J. G. Hunt,	do	53	02
3.	Chas. F. Chandler,	do	42	00
11.	Erastus Brooks,	do	46	85
11.	Dr. M. Smith,	do	9	60
	Dr. Elisha Harris,	do	98	35
Sept. 25.	Hamilton Ward,	do	20	30
30.	Dr. J. S. Delavan,	do	16	50
Oct. 13.	Jas. T Gardiner,	do	16	50
Dec. 2.	Erastus Brooks,	do	18	54
Dec. 4.	Dr. J. S. Delavan,	do	19	20
4.	Jas. T. Gardiner,	do	16	45
1881. Jan. 3.	Erastus Brooks,	do	101	25
5.	Dr. E. Harris,	do	82	00
7.	Dr. E. M. Moore,	do	60	98
Feb. 17	Dr. J. S. Delavan,	do	8	65
17.	Dr. Wm. M. Smith,	do	30	15
Mar. 31.	Dr. Jas. G. Hunt,	do	90	05

1881. Mar. 31.	Dr. J. S. Delavan,	expenses	....	$42 38
May 14.	Dr. E. Harris,	do	....	173 05
19.	Dr. E. M. Moore,	do	....	34 17
19.	Dr. J. S. Delavan,	do	....	26 90
21.	Erastus Brooks,	do	....	35 75
June 18.	Dr. E. Harris,	do	....	185 61
July 27.	Dr. J. S. Delavan,	do	....	31 20
27.	Dr. Elisha Harris,	do	....	74 93
Aug. 3.	Dr. E. M. Moore,	do	....	18 05
8.	Dr. Wm. M. Smith,	do	....	27 30
30.	Erastus Brooks,	do	....	51 62
Sept. 1.	Dr. J. S. Delavan,	do	....	54 32
1.	Dr. J. G. Hunt,	do	....	69 31
Sept. 7.	Dr. Wm. M. Smith,	do	....	25 75
24.	Dr. E. Harris,	do	....	271 14
				$1,932 20

Miscellaneous Expenses at Central Office paid by the Secretary.

1880. Aug. 10.	Expenses	....	$28 90
1881. April	do	....	208 04
May 14.	do	....	30 00
June 18.	do	....	5 57
			$272 51

Grand Total.........................	$13,991 83
Balance in Treasury..................	1,008 17
	$15,000 00

The foregoing report comprises all the expenditures of the Board, in general and detail (except three bills for printing and expert service not yet presented the total of which is not in excess of the appropriation) from its organization in May 1880 to September 30, 1881, a period of sixteen months.

The expenditures of the Board for the ensuing year will be kept strictly within the amount appropriated for the purpose, and the committee, as advised by the Board, respectfully suggests that the Legislature may, with advantage to the State, authorize the expenditure of five thousand dollars in addition to the sum of five thousand dollars allowed by law for sanitary surveys, inspections and expert duties, which are now and will be required for successful work, and which the State should provide for in addition to the necessary work of local Boards of Health.

ERASTUS BROOKS, *Chairman.*
CHARLES F. CHANDLER.
EDWARD M. MOORE, *President.*
ELISHA HARRIS, *Secretary.*

Executive and Finance Committee.

Statement of expenditures under chap. 407, of 1881, from July 5th to December 31, 1881.

Traveling and Incidental Expenses of Chemists and Examiners.

1881. July	6.	Dr. S. A. Lattimore, per itemized acct. rendered..			$26 64
	6.	Dr. W. H. Pitt,	do	..	26 60
Aug.	10.	F. E. Englehardt,	do	..	21 39
	10.	Dr. E. G. Love,	do	..	23 50
	12.	A. H. Chester,	do	..	14 68
	30.	A. L. Colby,	do	..	23 77
	30.	Dr. DeLap Smith,	do	..	28 81
	31.	C. E. Munsell,	do	..	14 75
	31.	G. C. Caldwell,	do	..	27 56
Sept.	30.	C. E. Munsell,	do	..	4 00
	30.	A. L. Colby,	do	..	2 55
	30.	Cataract House,	do	..	49 00
	30.	Dr. DeLap Smith,	do	..	24 08
	30.	Dr. W. H. Pitt,	do	..	7 25
	30.	Dr. S. A. Lattimore,	do	..	3 18
Nov.	2.	A. L. Colby,	do	..	2 82
	10.	C. E. Munsell,	do	..	61 50
	18.	Dr. DeLap Smith,	do	..	37 08
	30.	Dr. W. H. Pitt,	do	..	21 55
Dec.	2.	A. L. Colby,	do	..	10 39
	3.	Dr. S. A. Lattimore,	do	..	22 27
	3.	do	do	..	20 05
	9.	Dr. DeLap Smith,	do	..	48 98
	31.	A. L. Colby,	do	..	71
					$523 11

Compensation of Inspectors.

July	30.	A. L. Colby, for July	$43 50
Aug.	30.	do August	50 00
	31.	Dr. DeLap Smith, for July and August	93 56
	31.	C. E. Munsell, for do	93 50
Sept.	30.	C. E. Munsell, for September	50 00
	30.	A. L. Colby, do	50 00
	30.	Dr. DeLap Smith, do	50 00
Oct.	30.	A. L. Colby, for October	50 00
	30.	C. E. Munsell, do	50 00
	30.	Dr. DeLap Smith, do	50 00
Nov.	30.	A. L. Colby, for November	50 00
	30.	C. E. Munsell, do	50 00
	30.	Dr. DeLap Smith, do	50 00
Dec.	31.	A. L. Colby	50 00
			$780 56

Printing and Stationery.

1881. July	7.	J. W. Wadsworth, comptroller, stationery....	$46	93
	7.	do do letter book..	3	25
Sept.	1.	E. Ellis, for blank books..................	7	50
	30.	A. L. Colby, stationery, per account........		60
	30.	Dr. DeLap Smith, do do		50
Dec.	15.	J. W. Wadsworth, comptroller, stationery....	15	50
	16.	Type writing, per account of Mrs. B. A. Rushton..........................	2	25
			$76	53

Purchases of Samples for Analysis.

July	30.	A. L. Colby,	per account,	$5	79
Aug.	30.	do	do	5	61
Sept.	4.	G. W. Banker,	do	26	84
	30.	A. L. Colby,	do	40	47
	30.	Whitall, Tatum & Co., (Apparatus)	do	136	28
	30.	do do	do	63	84
	30.	Dr. DeLap Smith,	do	5	98
	30.	A. L. Colby,	do	26	22
	30.	Dr. DeLap Smith	do	23	34
	30.	A. L. Colby,	do	26	93
	30.	Dr. S. A. Lattimore,	do	4	39
	30.	Dr. DeLap Smith,	do	25	12
	30.	C. E. Munsell,	do	3	45
	30.	Dr. Chandler, per account of Hastings & Hahn.		3	90
	30.	do do Whitall & Tatum (Apparatus)..........................		4	54
	30.	A. L. Colby, per account.................		6	33
				$409	03

Library and Literature for Chemists and the Board.

1881. Oct.	8.	Westermann, per account..................	$ 9	67
	8.	do do	22	19
	8.	do do	32	71
			$64	57

Postage, Expressage and Telegrams.

1881. July	30.	A. L. Colby,	per account..........	$	30
Aug.	30.	do	do	2	10
Sept.	30.	do	do	10	50
	30.	Dr. DeLap Smith,	do	3	34
	30.	Dr. S. A. Lattimore,	do		78
Nov.	2.	A. L. Colby,	do	8	86
	10.	C. E. Munsell,	do		50

1881. Nov. 18.	Dr. DeLap Smith, per account		....	$2 19
18.	do	do	....	1 60
18.	do	do	....	70
Dec. 2.	A. L. Colby,	do	....	7 86
9.	Dr. DeLap Smith,	do	....	3 04
16.	do	do	....	2 05
31.	A. L. Colby,	do	....	2 77
				$46 59

Recapitulation.

Travelling and incidental expenses	$523 11
Compensation of inspectors	780 56
Printing and stationery	76 53
Purchases of samples for analysis	409 03
Library and literature for chemists	64 57
Postage, expressage and telegrams	46 59
Total expenditures	$1,900 39
Total unexpended	$8,099 61

General Abstract.

Total payments (on itemized accounts) by Comptroller's warrants		$1,516 51
Total payments out of $700 advanced by Comptroller, August 29, 1881		383 88
Total		$1,900 39

Liabilities to 31st December, 1881.

For payments to eight chemists under contracts	$3,200 00	
For compensation and traveling expenses of two inspectors for month of December, printing, etc., not exceeding	200 00	
		3,400 00
Total payments and liabilities		$5,300 39
Remaining unexpended (of appropriation by Chapter 407), after all outstanding obligations are paid, to January 1, 1882		$4,699 61

ERASTUS BROOKS, *Chairman.*
C. F. CHANDLER.
EDWARD M. MOORE, *President.*
ELISHA HARRIS, *Secretary.*

Executive and Finance Committee.

REPORT OF THE STANDING COMMITTEE ON REGISTRATION AND VITAL STATISTICS.

To the State Board of Health:

Your committee in reviewing the results of its labors during the past year recognized the fact that the particular portion of duty entrusted to its supervision is of necessity a branch of sanitary reform, somewhat difficult to introduce and perfect in all its details. In the progress already made, however, and in the increasing frequency of reports and statistical information received at the Bureau of Vital Statistics, from all parts of our State, your committee hope to show that the anticipations expressed in its first report are in progress of realization; that the seed sown is already ripening; and that harvest is near at hand.

The labor of establishing a perfected and uniform system of registration of the vital movement of five millions of people, composed of all nationalities, and yearly increased by the great and never-ceasing flood of immigration that is constantly flowing in upon us through the great seaport of the Empire State, seems a task indeed; and when it is considered that every human life that forms an atom of the millions of breathing humanity existing in our vast commonwealth, has a history which, commencing at the cradle, rolls onward until the grave receives it, and that each event of every life may be of infinite importance both to the individual and its descendants, as well as contribute to the well-being of the State, the indispensability of vital registration, not only as a sanitary necessity, but also as a principle of political economy, must be admitted by every thoughtful mind.

Our statutes provide for the registration of the lands and property owned by each one of the five millions of its people, and even for those who, living beyond our boundaries, hold estate within this commonwealth. Books of public record are kept in every town and city in our State, — open to all, — setting forth, in minutest detail, the history of each parcel of land, and of each building upon its surface. Thousands of expert hands and minds are daily employed in making, keeping and preserving such records with mathematical precision; but yet how strange it seems that until recently the history of the life of the individual has been utterly ignored by the rulers of the people. If it is of such moment to the welfare of the State, that property should be registered, how much more does it concern the interests of society that the vital movement of those who own and improve such property should be equally well understood. The necessity of such correct understanding of the vital records of the race first originated in the minds of thinking men and women; the idea of State Boards of Health, correct and uniform registration not having obtained before their organization.

Previous to the appointment of the State Board of Health of New York, the State had no system of registration of vital statistics excepting in six of her cities. In many towns some attempts had been made to register births and deaths; but as no uniformity had been observed in the carrying out of the plan, the results were meagre and unsatisfactory. In the first report of your committee allusion was made to the importance of a uniform system of registering the three great events in human life, — birth, marriage, death, — as well as the recording with accuracy those diseases which yearly make up the death rate among the people. During the year that is past, every city, town and village in the State has received ample instructions together with concise forms, not only for the registration of the vital movement of the people, and the proper preservation of such records; but also simple practical methods for the recording of those diseases which have prevailed in their respective localities. Thus in eighteen months, nine hundred and forty-seven towns, three hundred and twenty-six incorporated villages and eighteen cities have been provided with methods for vital registration through the means adopted by the State Board of Health of New York. The results thus far secured have been gratifying, and have exceeded the most sanguine hopes of the committee. The number of correctly worded and properly attested certificates of Births, Marriages and Deaths, from all parts of our State that are being daily received at the State Bureau of Vital Statistics, which will be seen by reference to the following pages of the report, show conclusively that not only are the officials themselves, but also the people deeply interested and heartily alive to the importance of this sanitary measure.

Your committee, therefore, feels justified in reporting that at the end of this, the second year of the existence of the Board, the State of New York is provided with, and has adopted, a uniform system of vital registration.

Investigation of Prevalent Diseases.—As regards the investigation of prevalent diseases, much important knowledge has been gained. The reports on epidemic and prevalent diseases herewith presented, with concise memoranda as to the inception and progress of these maladies, accompanied, in many cases, by maps of the infected districts (for the most part voluntarily given) show conclusively the growing interest taken by the town and city officials, by the medical profession, and by the people in general, in aiding the committee in its labors for preventing the spread of diseases, and preserving health and life in the community. The committee believes that this its second report will show that, while laboring, as it has done, under many difficulties, and with inadequate laws to sustain its action, the work commenced is progressing most favorably, and that the State of New York in the near future will exhibit a system of recording the vital movement of its population, inferior to none in the civilized world.

The organization of local Boards, where none had heretofore existed, and the prompt and ready response made to the suggestions of the superintendent of vital statistics as to the administration of health laws, have been the great factors in the carrying out of the committee's designs. Wherever the efficient local Board exists, returns come promptly, and satisfactory information with regard to existing diseases has been obtained. Over a large portion of the State well-organized and scientific Boards of Health are now at work, and their number is rapidly increas-

ing. Epidemics of diphtheria, small-pox and other domestic pestilences have been met and conquered by their faithful labors.

The records of the State Bureau, which are open to all, show what organized and united effort has already accomplished; and when, as seems certain to your committee, each town and city in our State are working together on one uniform basis for the prevention of the avoidable causes of disease; when, finally, not only the State, but the National Board of Health, of which the local Boards are units, all combine in the much needed reform to which your committee has devoted its attention, then the great problem of the prevention of disease will have been solved, and the people of our land will appreciate the benefits of a uniform, exact and complete registration of all human lives in each commonwealth and in the Nation.

Respectfully submitted,

J. SAVAGE DELAVAN, *Chairman.*

RECORDS AND INVESTIGATIONS OF PREVALENT DISEASES.

AN ABSTRACT BY THE SECRETARY.

The law which created the State Board of Health and defined its duties having required that the Board shall have the supervision of the registration of vital statistics and of prevalent diseases, the duty of conducting this branch of its work has been assigned to the standing committee on registration and vital statistics. With simple forms for facilitating the preparation of records for registration and especially for the records of diseases, there is now accumulating a mass of well-attested facts and information. Voluntary and promiscuous contributions of information and correct observation relating to prevalent diseases are offered on every hand, but these are seldom comparable and ready for such practical uses as the best interests of the public health and sanitary knowledge require. The law for the better organization of local Boards of Health has conferred upon every such board the obligatory supervising of the registration of diseases and deaths, and as each board, under this new law, is required to have a competent physician as its health officer, the work of organizing the registration of prevalent diseases in any adequate measure, necessarily awaits the creation and working of the local Boards of Health, and these under the law of 1881, are becoming sufficiently well organized to warrant the use of the records they contribute. Thus far, that is, to the close of this year's report, the brief accounts of prevalent diseases presented by the committee on registration in the manner which here follows, have been especially useful in the work of the Board, and they are instructive to the people, because they consist of brief narratives of the circumstances and evidences of the operation of preventable causes and of results

of preventive and controlling sanitary measures. For this purpose the few records which here follow are submitted by this committee.

Small-pox as it has prevailed during the year 1881.—At the close of the Board's first annual report in December, 1880, numerous instances were quoted which showed the manner, and something of the extent of this diffusion of small-pox in the city of Troy and some other places in the State. The following are among the more notable instances of its prevalence during the year 1881.

Small-pox in Fremont, Sullivan County:—On the 31st of December, 1880, a patient who had recovered from small-pox was discharged from the small-pox hospital on Blackwell's Island, taking with him when he left the slippers which he had brought to the hospital with him and had there worn. The physician in charge of that hospital testifies that the patient did this in violation of orders from him. The doctor adds in his report: "Before leaving he took a bath and was then sent to the dressing room, where he was given the new underclothing which he had not before been allowed to touch. After dressing he was not permitted to return to his room, or to come in contact with any of the patients. All of the usual precautions were taken with his clothing such as fumigation with sulphur and subsequent exposure to the air." This discharged patient went directly by the Erie railroad to Fremont, the southwestern town of Sullivan county, where in the course of three weeks the contagion was found to be spreading from family to family. It was successfully combatted by vaccination, but not until after six deaths had occurred as mentioned in the Board's report.

Small-pox in Caroga and the region bordering on Hamilton County:—Small-pox was introduced, vaccination was publicly offered, and the town Board of Health of Caroga organized its duties promptly upon the written request of the State Board of Health. The contagion was quickly exterminated. It was also introduced into the village of Northville, Fulton county, where the directions of the State Board were promptly carried into effect, and the necessary means for vaccination supplied.

Small-Pox in the Poor-House of Fulton County, and as Spread from it.

I have the honor to report for the information and use of the State Board of Health, the following cases of small-pox, eleven in all, which occurred in this vicinity and under my immediate observation, in April, May, and June of the current year, giving a brief history of their origin, so far as known, and a record of their termination; also a short statement of the measures taken to prevent the spread of the disease.

Suttle P., a resident of Johnstown village, and a boarder at the Harden House in that village, some time about the middle of April had a peculiar eruption, which excited so much suspicion that he was unable to obtain board in Johnstown. He was admitted as a private boarder into the Fulton county poor-house, it being represented to the superintendent that three physicians had pronounced the eruption to be non-variolous. The date of his admission was April 18th. His eruption, by infecting several inmates of the poor-house, proved itself to be variolous.

It is said that while boarding at the Harden House, in Johnstown,

and while he was at his business during the day, his room at the hotel was used by certain parties, one of whom was a prostitute from Fultonville, who had recently recovered from small-pox. Hence the origin of his disease. During the whole course of the eruption, he suffered neither sickness, uneasiness, nor loss of appetite; and, until the nature of his eruption was proven by its works, he took his meals regularly at the private table of the superintendent. None of the superintendent's family of seven persons contracted the disease.

The second case in my list is Hall, an inmate of the poor-house, who roomed with Suttle. He was attacked April 29th, and died May 10th of confluent small-pox.

The third case is Mrs. Ferguson, an inmate of the poor-house. She washed clothing for Suttle before the nature of his disease was discovered. She had a mild attack of varioloid.

The fourth case is George Grant, a colored boy, who, during an attack of hematuria, had been an inmate of the poor-house, and had also roomed with Suttle. He was discharged cured of his first sickness, about April 23d, and went to Perth, in this county, to work on a farm. On May 5th he was returned to the poor-house with an eruption, which was at once recognized. It proved to be small-pox, and after a tedious illness he eventually recovered.

The fifth case is James Lancaster, an imbecile, also an inmate of the poor-house, and a room-mate of Suttle. He had varioloid mildly.

The sixth case was discovered in the village of Gloversville, in the person of Robert McGuire, who was an inmate of the poor-house at the time of Suttle's admission, and occupied the same room with him. Afterward he had found work in Gloversville. As soon as discovered, he was returned to the poor-house, where he died of the hemorrhagic variety of small-pox.

The seventh case is Mary ———, a Swede, who was doing housework in a private family in the village of Kingsboro, one mile from Gloversville, and two miles from the poor-house. The origin of this case is somewhat obscure. She arrived in New York from Europe last fall; spent the winter in New York city, and had been in Kingston but a few weeks. It was impossible to learn if she had in her possession any infected clothing.

The eighth case is John Tuttle, who died of hemorrhagic small-pox. How he was exposed is not certainly known, but it is known that he visited Johnstown while small-pox was epidemic in that village. He was a farm laborer, living and laboring some four miles from Gloversville, and two miles from the poor-house. He died in his own house of two appartments, in the midst of his family of wife and five or six children, who were all immediately vaccinated and escaped the disease.

The ninth case is Mrs. Herrington who also died of hemorrhagic small-pox. She was first discovered in a filthy hovel destitute of furniture, lying naked on a pile of straw, with the eruption well marked and already hemorrhagic, with a babe at her breast. The baby was immediately vaccinated and escaped the disease. The mother was removed to the Gloversville hospital where she could have proper care, but she succumbed. It is not known how she became infected. She had been employed as a domestic on the same farm where Tuttle was employed as a laborer. She was a prostitute and may have met with exposure as a consequence.

The tenth case is Dr. John E. Burdick, of Rockwood, who had varioloid in a very mild form. He probably contracted the disease from a patient whom he attended.

The eleventh case is Maggie Ward, aged fifteen, who had varioloid but a few weeks after her successful vaccination. The origin of this case is involved in utter obscurity, unless a somewhat improbable story which she told be true, which would point to infected materials as the source of infection. She resided three miles from Gloversville and one mile from the poor-house. She was removed to the Gloversville hospital.

During this epidemic all persons known to have been exposed to small-pox were vaccinated and placed in quarantine. Suitable buildings were erected on the poor-house farm, where infected paupers were treated. They were cared for in a building separately erected by the authorities of Gloversville. Dr. Burdick also had one erected for his own occupancy and one patient died at his dwelling. All infected places were thoroughly disinfected by sulphur fumigation and infected articles were either burned or thoroughly disinfected. Too favorable mention cannot be made of the untiring efforts of Dr. F. W. Shaffer of Gloversville, the faithful, intelligent and efficient health officer of the town of Johnstown, to which in a great measure is due the limiting and final extinction of the disease.

Respectfully submitted by

EUGENE BEACH,

Health Officer of Gloversville and Physician to Fulton County Poor-House.

Dr. Beach's report shows that there were twelve cases and four deaths.

Small-Pox at Johnstown, Fulton Co.

Report by the Health Officer.

A brief report in relation to the small-pox epidemic, that visited the village of Johnstown during the spring of 1881, is here submitted to the State Board of Health, and others interested in the public safety, as illustrating the importance of strict sanitary measures being instituted at the very first appearance of the disease, a thorough isolation of infected persons and a rigid quarantining of cases of modified small-pox or varialoid (cases so mild as to be scarcely recognizable). It was owing largely to a case of this nature that small-pox was spread through our community. At the outbreak of the epidemic there was no regularly organized and constituted Health Board in the town. The village trustees were acting in capacity of Board of Health, but they were without a health officer. This disadvantage, together with too great fear and cowardice manifested by the citizens, rendered concerted action difficult, and the efforts of the Trustees to stay the disease was made to some extent ineffective.

The first case of small-pox occurred in the family of David Smith, residing corner of Market and Green streets, in the person of his son Louis, who doubtless contracted the disease while on a tour to Washington, at the inauguration of President Garfield, March 4th. The symptoms of disease were first manifested March 15th, and small-pox was suspected, when other members of the family, five in number, were removed from the premises and the house was quarantined and such

precautionary measures taken as was thought would insure against further spread of the disease. But contrary to expectation, April 4th, Mrs. Nelson Fairchild, who with her husband were boarding in the family of Mr. Hillock, on Green street, two doors east of the Smith residence, was reported to have small-pox. The Hillock family, three in number, were removed, and Mrs. and Mr. F. were quarantined in house where she was taken sick. Mrs. F. was enceinte; had a miscarriage, followed by hemorrhage, and died April 20th. The theory of her infection was from fomites conveyed in the air from Smith's. Oliver Hays resided on West State street, and was taken sick April 13th; reported to have small-pox, April 16th. His wife and children were vaccinated and the children isolated as much as possible, although not removed from home. Hays died April 24th. The source of infection is obscure.

The next case, the most obscure of all that occurred, both as regards manner of infection as well as nature of the disease, and the most mischievous case of all, was that of Parker Settle, a bachelor, aged about 50. Settle boarded at the Harden House, a hotel, corner Main and Perry streets; he was an epileptic, was taken with a seizure April 15th, but emerged from fit in about the usual time, felt, however, more prostration than was usual after similar attacks, which continued for two or three days, when a few isolated papules appeared on his face. This gave rise to some alarm on the part of the frequenters at the hotel, and Settle was induced to consult a physician, which resulted in his being pronounced free from small-pox. This assurance did not, however, quell the public fear, and Settle became a terror to those with whom he came in contact, and was finally driven from his boarding house and rejected by all others, consequently was forced to appeal to the authorities who sent him to the alms-house. After two weeks sojourn here, two cases of small-pox were reported and suspicion at once fastened upon Settle as the source of the contagion. This suspicion, no doubt, was well founded, as the poor-house was four miles from the village of Johnstown, and there was no other way for the disease to originate. Dr. Eugene Beach, health officer for the village of Gloversville, had charge of the cases that occurred here and will, doubtless, report them to the State Board of Health. The last three cases mentioned, viz.: Hays, Fairchild and Settle, constitute the second crop of small-pox that occurred here.

The next group of cases broke out between April 26 and May 1.

Henry Martin, resided on Perry street; was taken sick April 26.

Richard Rider, resided on Williams street; taken sick April 26.

Howard Hays, taken sick May 1.

Chester Hays, taken sick April 26.

Mrs. O. Hays, taken sick April 28.

The two children had small-pox and died. Mrs. H. had varioloid. These were the family of Oliver Hays before mentioned.

Mr. A. Hathorn resided on Main street, and was taken sick April 28.

Hiram Yanney, residing on Perry street; taken sick April 28.

Daniel Kennedy, resided on Perry street,; came down with small-pox April 28,

Mr. McLain resided on Prospect street; taken sick April 28. There were nine members in his family; four other cases of small-pox occurred.

Mr. P. Holman, resided on Gleeb street; taken sick April 29; six in family, one had small-pox.

Howard Shull, resided on Perry street; taken with small-pox April 30.
Daniel Wormuth, resided on Cayadutta street; sick May 1.

Mr. O. Peck, resided on East State street; taken May 1; six in family. Two more cases reported here. This comprises the third crop of small-pox that occurred in our community. Eight of these cases were confluent. Three proved fatal. The other six cases were varioloid. Eleven of the number were infective by personal contact with Settle. Most of the cases included in third crop were removed to pest house as soon as reported to pest house (as the-community were sufficiently aroused at this juncture of affairs to procure such an institution and a health officer had been appointed and was acting in concert with the Board of Health which was now regularly organized,) crowded families where small-pox had broken out were quarantined and strictly watched, houses thoroughly fumigated and disinfected where contagion had been.

About May 13th seven other cases occurred in the following families: Two in O. Peck's, father and sister to O. Peck already reported; these were varioloid. The father was over eighty years of age, colored. Four cases broke out in the family of Mr. McLain on Prospect street, also reported; three varioloid. One confluent small-pox. The last case was in the family of P. Holman, Gleeb street. This is the fourth and last crop. The whole number of cases of variola was thirteen; none had ever been vaccinated. There were eleven cases of varioloid, all of which had been vaccinated in early life. About May first at the suggestion of the State Board of Health a house-to-house visitation was provided and vaccination enforced as far as could be.

Respectfully,
R. H. CAMERON.

Small-Pox in Glens Falls and Queensbury.

The following report has been made by the health officer of Glens Falls and Queensbury.

To the State Board of Health :

The following is a brief report of an outbreak of small-pox in our village last summer : The disease first appeared late in June in the family of Adolphus Guyette, on the corner of Elm and Orville streets, near the western limits, and simultaneously on Montcalm street ; still further west, outside corporation limits, in the family of C. Barney, and at the house of George Guyette, on the Hackett road. The contagion was brought here by a son of said Adolphus Guyette, who had just left his place of employment at a hotel in New York to visit relatives here. He spent one night or more at each of the above-named places. He had a crusty eruption on parts of his face at that time. In about two weeks after his arrival here small-pox made its appearance in the families which he had visited. The houses in which the contagion thus appeared were immediately quarantined, and vaccination commenced in the infected district and immediate vicinity. Steps were then taken by the village Board of Health to secure a site for a hospital, which resulted in the erection of one on the bank of the river, a short distance below the State dam, on lands owned by Messrs. Finch, Pruyn & Co., who kindly gave permission. Meantime other cases appeared on

Montcalm street, and when the Board of Health was about to remove them to the hospital, the proprietors, on whose land the hospital had been erected, refused to have it occupied, thus making it necessary to find another location. About this time the town Board of Health perfected its organization, took the matter in hand, and erected a hospital about one mile and a half west of the village. Fearing that the disease might appear in two extensive manufactories of shirts and collars, the health officer required that all the operatives should be vaccinated.

The proprietors, Messrs. Libby & Spier, and Messrs. Fowler & Co., promptly responded. They posted the rule for vaccination, and enforced compliance with it, and none of their employees were allowed to work without a certificate of approved vaccination from a physician.

In addition to this precautionary measure, these manufacturers placed their entire stock of freshly-made goods, which were being daily received from the dwellings throughout that district of country, in which much material is distributed for making up, under the health officer's control. The goods were subject to protracted sulphurous fumigation in closed apartments at the factories.

By this means not a case occurred in either of these buildings, wherein about six hundred persons were employed, and consequently there was no interruption to their business.

Much credit is due to the proprietors of these factories for their prompt and energetic action in this matter. The town Board of Health offered free vaccination to all, and the town and village were divided into inspection-districts, and a physician appointed in each district to vaccinate all who would avail themselves of this protection. Unfortunately the physicians who attended to this gratuitous offering of vaccination neglected to keep complete records of the work, consequently I am unable to give the *percentage* of those that received benefit from vaccination or re-vaccination. About three thousand two hundred (3,200) were vaccinated in all, however. Bovine virus was obtained from Chelsea, Mass., the Dispensaries, New York, and the Health Department of New York city, the last mentioned having our decided preference.

Up to the time of the completion of the hospital, about the 16th of August, fifty cases of variola and varioloid had appeared in the infected district, which had been kept under rigid quarantine. The first case that was taken to the hospital was on the 16th of August. The whole number admitted, thirty-two ; number of deaths, five. Number treated in private hospital huts, erected near the first or public one, three. Whole number of cases treated at home, fifty-eight, eleven of which died. Whole number of cases of small-pox, including varioloid, since its outbreak in June last up to November first, at which time the disease was suppressed, and the hospital closed, ninety-two. Total number of deaths, eighteen, or about nineteen and one-half per cent. In view of the large number of cases which occurred before we established our hospitals, and the rapidity with which the contagion spread, it seemed impossible to suppress it, or prevent its spreading through the entire village and town; but by untiring efforts, both night and day, a prompt removal of all new cases to the hospitals, and a thorough system of vaccination, we have conquered, yet not without opposition, as ill-timed as it was useless. It is to be regretted that our entire community

did not at first act as a unit in vanquishing this formidable enemy; yet, with two or three exceptions, the physicians acted with the Board of Health, and were ready to second its efforts in suppressing the disease. Through the influence of these dissatisfied doctors, a spirit of opposition showed itself in the community at large, which tended to retard and embarrass the labors of the Board of Health and health officer in particular. Too much praise cannot be awarded to Dr. W. W. MacGregor, who so nobly and fearlessly assisted the health officer in this trying ordeal; ever ready and willing to do battle against this fearful enemy, he rendered prompt and efficient aid in stamping it out. Appended is his report as physician to the hospital ——— Dr. E. L. R. Chapin rendered valuable assistance in treating the sick in their dwellings, and heartily co-operated with the Board of Health, as did also Dr. Eddy.

And to the State Board of Health we are indebted for prompt and valuable advice in our time of affliction. It was by your kind encouragement that we were enabled to do battle more zealously and fearlessly against the dreaded enemy, for which kind aid and assistance accept our thanks, and through us the thanks of our two Boards of Health.

M. R. PECK, M. D., *Health Officer.*

GLENS FALLS, *December*, 1881.

The Hospital Report.

Dr. MacGregor concludes his report for the season as follows:

"The hospital doors are closed, and I trust it may never be necessary to re-open them. As physician in charge, I respectfully submit the following report:

Number of cases treated in hospital				32
Number died in hospital				5
Average number of days each patient in hospital				15-33
Number of patients under	5	years of	age	5
do	do	10	do	8
do	do	20	do	10
do	do	30	do	5
do	do	50	do	3
One patient	67	do		1
Total				32
Number in all, patients and friends who came with them				47

Per cent of death in hospital, 15.62.

"There were two private hospitals erected near the main one, in which there were three patients, two of whom died from hemorrhagic small-pox. (Signed), W. W. MACGREGOR.

"GLENS FALLS, N. Y., *Nov.* 9, 1881."

SMALL-POX ON EMIGRANT TRAINS, AND AS SPREAD BY THE EMIGRANTS.

Warnings and action of the Health Officer of the Port of New York to Prevent the Spread of Small-pox by Immigrants. — Throughout the last six months of 1880, and until the present time, the health officer of the port of New York has lost no opportunity to advise and warn the health

authorities throughout the United States whither immigrants go from Castle Garden, that the utmost vigilance and care will be necessary to prevent the outbreak of small-pox from contagion unsuspectingly conveyed by immigrants and their baggage.

Dr. Smith, health officer, has given very good reason for this warning, after all the sanitary precautions which the laws authorize him to adopt at his station, the gateway of immigration; namely, that a large proportion of the European immigrants are landed at Castle Garden from one to four days before the usual period of incubation (14 days) of small-pox contagion has expired and consequently that such migrants may reach any point by railroad transportation between New York and the Mississippi before the recognition of the development of small-pox contagion that may have been contracted at the port of departure, or from infected baggage.

Buffalo Health Officer's Action. — During the months of April and May small-pox appeared upon emigrant trains, and among the emigrants arriving at Buffalo. May 23d, the health officer of that city communicated to the common council the following statement with reference to the dangers impending in Buffalo, which had then a fatal illustration in the tenements occupied by Polanders in Alabama street:

BUFFALO, *May* 23, 1881.

"I desire to call your attention to the over crowded condition of several tenement houses in the city, especially in the Third ward, chiefly situated on Carroll and Alabama streets, and occupied generally by Polanders, who are very filthy in their habits. The Board of Health under title XII, section ten of the charter, have the power to remove families from overcrowded buildings. The danger from small-pox, caused by the arrival of emigrants from infected steamships and other vessels, moving into these already overcrowded tenements; renders it necessary that they should exercise this power at once as a matter of public safety. The question that confronts the city authorities is, "what shall be done with these people?"

"I know of no better, or more economical way of caring for them, than for the city to build sheds, or barracks of cheap lumber on some of the large vacant lots in the eastern part of the city, at some point where hydrant water can be obtained in abundance, and establish a sort of a quarantine for these disease-suspected emigrants, where they can be housed on their arrival, at least during the summer. They can thus be made comfortable, and the public health preserved from the infectious disease they are liable to impart.

"I suggest that all families of emigrants arriving hereafter suspected of disease be required to take up their residence at such place when established, until all danger from small-pox has passed away. Within the past three weeks we have had several cases of this loathsome disease; and in every instance it has been among emigrants."

Your attention is called to this matter as one of grave importance, and prompt action should be taken.

Respectfully submitted,

A. H. BRIGGS,

Health Physician.

The common council immediately took the following action: That the Board of Health, together with the committee on sanitary matters, be authorized to take measures to overcome the difficulty, at an expense

not to exceed $500, and that the health physician be directed to communicate with the commissioners of emigration in New York to ascertain the best mode of relief.

Adopted.

This beginning of a defensive work in Buffalo was urged by the State Board of Health to be extended sufficiently to give full protection to the emigrant trains before passing beyond the limits of the State of New York. Temporary barracks were constructed in Rich street, East Buffalo, and the infected houses on Alabama street were speedily cleared. Numerous uninfected families of that district were temporarily housed in dwellings on Best street. The prompt action of the Common Council enabled the Board of Health to appoint suitable medical assistance, "and they called upon the Superintendents of the Erie and Central railroads, and they not only heartily indorsed the plan, but promptly furnished regular transportation to and from Attica and Batavia. During the week the two physicians have boarded every emigrant train at the stations named, and examined every immigrant for contagious disease. In case of small-pox, the car in which the patient is found is cut off at East Buffalo, thoroughly disinfected, and the necessary precautions taken to prevent the disease spreading. The wholesome benefit resulting from this system can be readily appreciated."

This practice continued so long as there was daily great danger from the arrival of emigrants in the first periods of small-pox. It was then, and is still, urged by the Buffalo Board of Health that such action can be taken, that at, and between the emigrant ships and Buffalo there shall be an efficient sanitary inspection of every emigrant train, all along the great highway of travel — from New York city to the West. These emigrants are the cause of most cases of small-pox, it having already made its appearance at Hornellsville, Buffalo, and Suspension Bridge."

"Our method is to meet the incoming trains at some convenient point outside the city, far enough away to give us ample time before the train arrives here, to inspect every passenger the train contains. This work we propose to continue during the summer, and as much longer as the flood of immigration keeps up. I am satisfied that all that is needed to keep small-pox and other infectious diseases from being spread throughout the country by these immigrants is the hearty co-operation of other local Boards of Health," aided by the State Board and National Board, in carrying out the system."

Action at the Chicago Conference.—Early in June a movement in harmony with this in New York was organized in the western States, and a conference called to meet at Chicago, June 29, at which a delegate attended, for the New York State Board of Health and to which this Board communicated the following suggestions, which were in substance adopted:

"That inasmuch as the migration from Europe to the United States for many months to come will continue to exceed any former experience, sanitary regulations will need to be adopted at all ports of departure whence the contagion of small-pox is liable to be brought to this country by persons and baggage; further, it may not be practicable to enforce such quarantine detention at the ports of arrival in the United States as to remove and prevent all possible means of conveying the contagion far inland. Therefore, in view of these facts, the

health officer of the Port of New York, and the sanitary authorities represented in the Chicago conference had before them the question, "How shall the contagion, that is developed while the emigrant is *en route* westward from New York and elsewhere, be most speedily discovered and controlled?"

These propositions for such sanitary service relate to those letters, and with the action recommended by the New York State Board, as well as by the National Board of Health. The propositions for such a sanitary service relate to

(1) Reinspection Stations,
(2) Local Quarantines,
(3) Positive Preventive Sanitary Regulations in Europe.

It seems obvious that international *sanitary obligations*, and certain official methods and forms must be agreed upon. These should be at once provided by *international agreements*, such as—

1. A system of thorough inspection and vaccination at every port of departure in Europe and the North American States, of all unprotected emigrants. This may be secured by the National Board of Health, and the President of the United States at all ports in our own States, and by the comity of international agreements with the governments of Europe at all their ports.

2. By adding to the utmost efficiency of the quarantine systems of each American port such form of records and symbol-cards* that the persons who, among the emigrants, are believed, and by inspection are certified, to be protected, shall pass without hindrance on their way through our country; and by a suitable variation of symbol-cards*, also to provide the indication or sign, by which all persons who need shall be reinspected as they move onward.

3. To bring into full accord the State and National Board of Health methods of co-operation for the prompt destruction of small-pox wherever it may appear at central stations along the routes of migrant travel by railroad and steamboats.

4. To secure in every State the most effectual means of local and the necessary State control over the discovered sources of contagion, the quarantining of the sick, and the vaccination of persons.

In conclusion, the undersigned would state it as the conviction of the sanitary authorities whom they know, generally, at the east, that in the present course of immigration, there is greater security in the speedy dispersion of the vast companies of migrants, as soon as all evidence of the presence of the small-pox contagion is closed and in a practical way provided for, than could be obtained by a longer detention of these companies. Though it may be only a *choice* between possible perils, the least of the two perils is to be accepted, and the greatest possible degree of justice and all available means for self-care and safe-guarding shall be insured to the greatest number.

Reinspection and a system of *international* as well as *State agreements* and means for obtaining the protection of our entire country against small-pox, may, as we believe, be so devised as to insure the approbation and cordial support of all concerned in the repression and extinction of small-pox.

The details of the plan for insuring protection to every emigrant

* This has been adopted and is termed the vaccination protection card.

before departure from any port in Europe, and for re-inforcing the safeguards as the migrants disembark at any port and pass into, or across, the States, can be arranged.

This statement was drawn up and signed by a committee of this Board, authorized to present its views to the Chicago conference, and it is fully in accord with the action taken at that inter-State meeting.

Small-Pox at Lockport.

Early in October a Mrs. P. died of small-pox that was certified by the medical attendant as erysipelas and acute eczema. Other cases of small-pox followed in the same family and in families living in the same house. These cases were not reported as small-pox until several were already suffering from varioloid. Immediately upon the discovery of the malady, the city Board of Health assumed control and directed the Health Officer to appoint eight physicians to assist him in house-to-house vaccination, which duty was rapidly performed until the city thus gained protection against the contagion.

As soon as the nature and extent of the danger had become known in Lockport, the facts were judiciously communicated to the sanitary authorities of the city of Rochester, which is only two hours distant by rail, who provided effectual means for the best vaccinal service by physicians through that city.

Various vaccinal farms supplied Rochester at the rate of 1,000 slips every second day until 40,000 people there had been vaccinated.

Inquiry into causes that led to neglect to report the first cases of small-pox in Lockport, has taken a judicious form and will result in the public benefit.

The Health Officer of Lockport, Dr. W. J. Ransom, reports that from October 20th to January 1st, fifty-three cases of small-pox occurred, and that during this interval of ten weeks the city and vicinity were put in a condition of thorough protection.

Note.

The conditions under which complete protection against small-pox has been enjoyed by numerous communities, some of them situated in the midst of and between cities and villages in which small-pox was ravaging the population, present conclusive evidence of the protection which vaccination affords. The complete protection secured by several crowded and extensive manufacturing establishments has been so confirmed as to leave no doubt that this security was attained solely by vaccination of the unvaccinated, and re-vaccination of the other employes.

Small-pox has been harming the State only where the neglect of vaccination invites the fatal contagion. It has spread in no school or factory, or other assemblage, where there had been even reasonable attention to vaccination, and it has been arrested readily and completely only where vaccination and re-vaccination were promptly and universally offered. Its continued prevalence in any place of business and trade in such city, has been due to the neglect of the local Boards of Health whatever other causes have been in operation. In one city of less than 60,000 inhabitants the continued prevalence of the contagion is said to have harmed its trade interests to the extent of more than a

12

million dollars in ten months; and had not the health authorities of Buffalo promptly controlled the contagion in that city, its trade losses would have been in excess by one hundred fold the cost of the health government there during the past year. In no place in New York has small-pox found such an unguarded population as it frequently has in States further west, and even in the neighboring State of Pennsylvania. The following letter from the Mayor of Allentown, Pa., conveys an instructive lesson to all communities in which vaccination and prompt sanitary procedure are neglected:

MAYOR'S OFFICE,
ALLENTOWN, PA., *Dec.* 19, 1881.

Secretary State Board of Health, New York:

Dear Sir — Please accept thanks for your promptness and kindness in sending information, advice and instructions to us. About six weeks ago a child was taken with small-pox and died without a physician having been called in. It was pronounced a case of measles by the family. A public funeral was held. Before this time our city had been remarkably free from the disease. When a case presented itself, measures were at once taken to prevent the spread. The father of the above named child made clothing for a merchant tailor, one of the members of the family worked in a large cigar factory, and there had been a very free interchange of visits by the neighbors. A few days after the funeral the whole family (eight persons) were down with small-pox, and in less than five days we had thirty-four cases in different parts of the city. You can readily imagine the panic and consternation that followed. We immediately took measures to prevent the spread; urged general vaccination; quarantined the families as far as was possible with the small force at our command. Unfortunately the city councils did not give the Board of Health the encouragement it required at the outset, and the Board being restrained to some extent was not able to take the strenuous measures it subsequently did, after the council removed all barriers.

We have had one hundred and three cases, and twenty-three deaths. A large number of the fatal cases had exhaustive hemorrhages from the nose and throat; were confluent, dying of congestion of the lungs, congestion of the brain, or from exhaustion. We found that all cases that were confluent had never been vaccinated, or never since childhood.
* * * * *

DIPHTHERIA DURING 1881.

This disease continued to be reported from different parts of the State every month in the year. Its devastations have been greatest in the districts which, until within the past few weeks, had no sanitary organization, yet in the cities of New York and Brooklyn the total mortality from diphtheria has been large, 1152 deaths having been recorded in Brooklyn, and 2249 deaths in New York in the year. The published reports of city Boards of Health show how tenaciously the cause of diphtheria clings to crowded districts.

Diphtheria in Salamanca.—The secretary of the Board of Health in this village on the 5th and 13th of May communicated the following facts: "We have had a number of cases of diphtheria in two weeks,

nearly all fatal. The first case was thought to be membraneous croup, and no attempt was, therefore, made to keep the other children from that patient. Two in this family died, also a cousin, allowed to be with them. A girl working in the family was next taken. She went home and recovered, but she had communicated it to four others in the family, three of whom died, and one is now sick. Another family, where we cannot positively trace the infection, had two light cases, young ladies; both recovered. We now have one more case, some distance from others, where we cannot trace infection."

The Board of Health organized and worked effectively, published and posted the recommendations of the State Board, cleaned up their village, and instructed the ignorant concerning their sanitary duties.

Diphtheria in Warren and Essex Counties.—Through a district of some fifty miles in length, northward from Warrensburgh and Johnsburgh, and extending westward over a width of at least twenty-five miles from Schroon lake and its outlet, diphtheria prevailed in its most malignant form until late in the autumn. The inhabitants of Chestertown and Schroon organized their town Boards of Health late in the summer, and secured effective methods to check the spread of this contagion. In the towns of Minerva and Johnsburgh the disease continued its devastations until late in the autumn. The following extract from an appeal of a school district clerk in the mountain region of Johnsburgh, correctly sets forth the situation of one of the remote regions of its prevalence:

"Our town has been terribly imposed upon by careless persons in regard to diphtheria. There are several cases close by me. They take the clothes of the dead and hang them out near the highways, and throw their slops about. Even those who attend the sick run out and in at all places, spreading this diphtheria in all directions. I am afraid that my family will perish with the rest of them, if there is not something done to protect the people in all parts of this town. There must be something done to stop the spreading. There have been three deaths this last week, and a number more are expected to die. I think the State Board is in duty bound to take notice of this contagious disease that is killing off our people. Our town has lost within two years perhaps four hundred with this disease, and no one to say a word to stop it spreading. It is not only for my own family, but for all my fellow townsmen that I write. Some action must be taken."

Remote from physicians, and hitherto unreported to the State Board of Health, the families and neighborhoods that were suffering were not to be neglected for a day, however exaggerated such a statement might prove to be. Dr. James S. Cooley, health officer of Luzerne, was immediately commissioned by telegraph to go through the affected regions of Johnsburgh, and to extend his investigations as far as he found there was any extension of diphtheria, to give the people all needed information and counsel, and to confer with medical men wherever he found they had been in attendance upon diphtheria. This efficient sanitary helper complied with the request, and has made the following brief report upon his observations in that field:

Dr. Cooley's Statements.

While upon the first tour of investigation Dr. Cooley writes: "I have spent two days in the north-western part of the county. I found a bad

state of things in Johnsburgh, owing to an almost total disregard of any precaution as to spread of disease. An undertaker, living at Weavertown, laid out a child two miles away, and carried home the infection to two of his children. I have enlisted help there in getting at the facts. I think the report from the clerk of school district No. 3, of 400 deaths from diphtheria is not much exaggerated. At Indian Lake, there has been a sad state of things; twenty-two deaths are reported within the last few months, from diphtheria and typhoid fever.

I have the honor to report as follows upon the outbreak of diphtheria in the towns of Chester, Warren county, Minerva, Essex county, in accordance with instructions from you:

Diphtheria in West Chestertown.

Chestertown is one of the northern tier of towns in Warren county, lying between the Hudson and Schroon rivers. The portion here referred to is the north-east corner of the township, situated next to the town of Minerva, Essex county. The land lies high, is generally well drained, and the soil a gravelly loam.

The first group of cases of diphtheria, of which we can find an account among the people and their physicians, occurred in December, 1877. Daniel Shaw's wife and two children, aged 5 and 3 years, respectively, were attacked with the disease. The children both died, one on Dec. 13th and the other on Dec. 16th. The mother recovered. The source of contagion for this family was probably some case in the adjoining town of Johnsburgh, where Mr. Shaw did his trading.

A neighboring family by the name of Higgins was next to suffer. A daughter in the family visited at Mr. Shaw's during the illness of his children, and a grandchild in the H. family was brought home from North Creek, when recovering from diphtheria. From one of these sources the Higgins girl was infected, and she and three other grandchildren living in the house had the disease and all recovered.

The second group of cases occurred some months later, in July, 1878, in the family of F. Smith, living about one mile from Mr. Higgin's, mentioned above. Mr. Smith saw a case of diphtheria at North Creek, and a few days after, his daughter, aged 13, was attacked with the disease, and shortly after his youngest child, a boy of 4 years; the girl died during the night of July 1st, and the boy the next morning. His other boys, three in number, had the disease, but all recovered.

The third group was in August and September, 1880. Henry Russell's sister saw or took care of a case of diphtheria out of town, and came to her brother's to care for his invalid wife. R.'s boy, aged 13, and a hired girl took the disease, and the boy died.

William Goodspeed, Russell's brother-in-law, came to Russell's while they were sick, and attended the boy's funeral. As a consequence, Goodspeed's two boys were taken August 20th, and 24th, respectively, and died August 23d and September 5th. The infection was undoubtedly brought by Russell's sister.

There were mild cases in other parts of the town, but no deaths, except in W. Russell's family, one child died out of four who had the disease.

All of these cases appear to have resulted from carelessness or ignorance of the danger of exposure; and these eight deaths and upwards of

twenty cases of this dread disease, preventable by enlightened sanitary precautions.

West Chestertown.

Family of	Number in family.	Number of cases of D.	Number of deaths.
1877.			
D. Shaw	4	3	2
Mr. Higgins	3	5	
1878.			
F. Smith	7	2	2
1880.			
H. Russell	8	2	1
Wm. Goodspeed	4	3	2
W. Russell	6	4	1
Totals	27	20	8

Diphtheria in Minerva, Essex County.

Minerva is the south-western town of Essex county, and the following group of cases of diphtheria occurred in the south-east part of the town, in the hamlet, known as Olmsteadville, near the Warren county line, situated on the Minerva creek, and at a considerable elevation. The diagram shows only the location of the dwellings where the disease occurred.

Early in April 1881, Dr. J. C. Wall, to whose care and labor I am indebted for the facts in reference to these outbreaks in West Chester and Minerva, was called, professionally, to see a little girl of Thomas Barss sick with diphtheria. The Barss girl recovered, her case probably being a mild one. But alas,

Dr. Wall had four children whose ages were from two months to four and a half years. To these he brought the infection, and as a result, one child was seized with the disease April 11th, and two others on the 12th, and all died. Mrs. Wall also had the disease, but recovered.

The adult members of the families of J. Lyndsay, Charles McGinnis and P. Sullivan, who were relatives of Dr. Wall's family, were frequently at the doctor's house during the sickness of the children, and were present at the funerals which were held at the house and fully attended.

April 28th the disease appeared at J. Lyndsay's, where there were five children, all of whom had the disease, and two of whom died.

The following day, April 29th, the McGinnis family was attacked; here were also five children, two of whom died.

One week later, May 6th, four children and a servant girl in the family of P. Sullivan were attacked with diphtheria at the same time. Of these, all recovered but one child.

Wesley Barnes had attended many of the funerals, and his family were the next to suffer. On May 12th his children were taken sick, but all recovered.

While Barnes' children were sick, *other children visited* the house, among them a daughter of Mrs. Sherman, living west, across the creek, who was attacked with diphtheria June 24th and died.

Mr. Morrisy's boy also took it home and three of Morrisy's children had the disease and two died. Morrisy lives up the creek from Mrs. Sherman's.

O. P. Morse lives opposite Mrs. Sherman. His niece, living with him, was attacked June 15th, but recovered.

S. P. Cobb's boy visited at Barnes' during the sickness there. He was attacked with diphtheria June 22d.

Other cases occurred during this period, the exact data of which I have not been able to obtain. But the terrible nature of this scourge is evident from the fact that there were twenty-seven deaths out of fifty-six cases.

From this narrative some conclusions may be deduced which are worthy of special notice:

1. Mild cases of diphtheria may be the source of contagion that soon results in succeeding cases of great severity.

2. Carelessness in visiting the sick and in attending funerals may spread the germs of this fearful disease far and wide. The funerals were all held at the houses where the deaths occurred and were generally fully attended.

Olmsteadville.

Family of	Number in family.	Number of cases of D.	Number of deaths.
J. C. Wall, M. D.	6	4	3
J. Lyndsay	7	5	2
C. McGinnis	7	5	2
P. Sullivan	11	5	1
W. Barnes	6	4	
O. P. Morse	3	1	
Mrs. Sherman	2	1	1
M. Morrisy	6	3	3
Totals	48	28	11

There were cases in the families of L. Hammond, C. Bissell, Mrs. D. West, and S. P. Cobb, but the facts are not at hand to tabulate. All of the above cases occurred between April 2d and June 27th, 1881.

All of which is respectfully submitted,

(Signed) JAMES S. COOLEY, M. D.

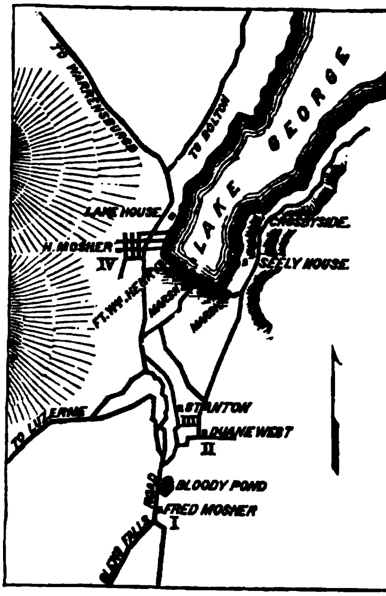
LUZERNE, N. Y., *January* 3, 1881.

Note on the Introduction of Diphtheria in the Village of Lake George, Warren County.

While investigating the course of diphtheria in the mountain districts of Essex and Warren counties, the following account of the introduction and limited spread of this disease in Lake George village was communicated by health officer Adamson.

In January, 1878, Mrs. M. went to Albany, taking with her George, a little boy three years old. The little fellow was quite well at supper-time, but taken sick shortly afterward, and died at four the next morning. The attending doctor gave a certificate of death from membraneous croup, and the body was brought home for burial, and the coffin opened at the house (marked on accompanying sketch I). Within a few day a brother of George, named Charlie, aged five, was taken ill and died from diphtheria. Willie West, aged six, a cousin of the afore-named (at house marked II) was the next, he died; then his mother, Julia West, was taken ill and died; then Howard W., aged three, died. (At the house marked III) Morris Stanton lost two children, both from diphtheria, about the same time. An aunt and uncle of the two first mentioned children had diphtheria, but both recovered (at the house marked IV). These cases all occurred between January 12th and February 14th, 1881. Duane West, having lost his wife and children, left

the house marked II, and shortly afterwards it was occupied by another family. I do not know their names, but a relative of theirs, who paid them a visit, was shortly afterward very ill from diphtheria and, I think, died.



SPECIAL INVESTIGATIONS OF DISEASE IN RICHMOND COUNTY.

As one of the earliest results of the observations and records instituted by the Board of Health of New Brighton, was a demonstration of the fact that the death-rates in different districts of the exceptionally salubrious and beautiful town of Castleton, within that Board's jurisdiction, vary so greatly as to be accountable only upon the supposition that local causes and domestic conditions will adequately explain the excessive mortality in particular streets and upon numerous well defined areas in the township. The State Board invited Dr. Alfred L. Carroll, the recent president of the local Board of Health, in Castleton, to undertake certain investigations concerning the endemic fevers and other diseases in the counties of Richmond, Kings and Westchester. His preliminary report is here appended, and it relates to only the first question submitted to him for his examination and reply.

Notes on some of the Sources of Endemic Diseases in Richmond County.

BY ALFRED L. CARROLL, M. D.

Richmond county, the surface of which, throughout nearly its whole extent, consists of a bed of glacial drift and disintegrated magnesian rock of varying thickness, has long held prominent rank among the malarial regions of the State, and during the past year its endemic fevers have shown a marked increase in prevalence and in severity. Intermittents and remittents have in an unusual number of instances assumed the pernicious form, and "typho-malarial" fevers have prevailed in several localities. As regards these latter, two classes of cases appear to be distinguishable; one in which true enteric fever and malaria co-exist in the same person, and another wherein common filth-poisoning superadds its depressing influence to a malarial attack.

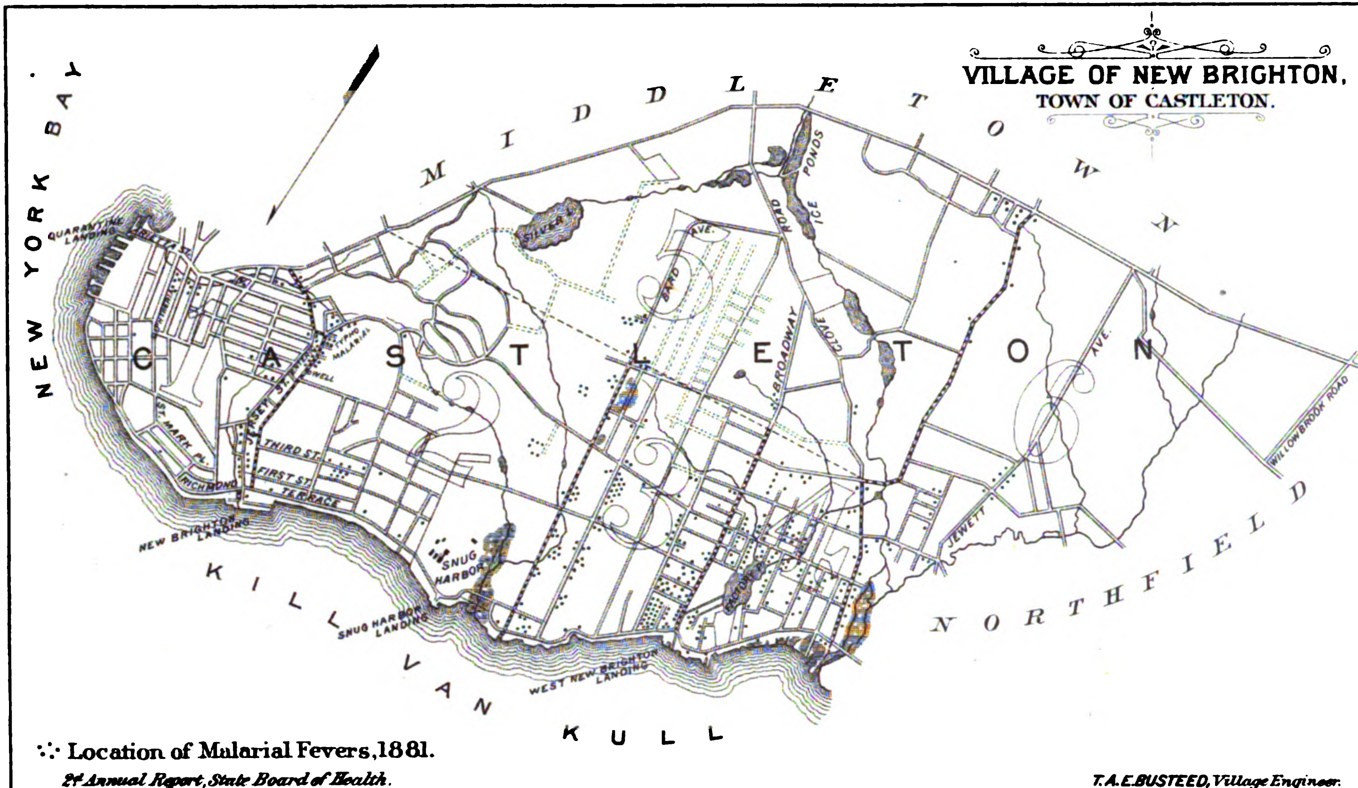
The accompanying sketch will show the localities of the less usual endemic fevers as far as my present information extends. Of the lower part of Westfield, I have no recent knowledge, but in past times the districts about Tottenville and Pleasant Plains has produced severe forms of malarial fevers and numerous cases of typhoid. No tract of any extent in the country is free from malarial diseases, even the higher elevations of Castleton and Middletown furnishing numerous examples. Along the shores lie about eight thousand acres of salt marsh; scattered

through the interior are ponds and swampy lands, aggregating many hundred acres, whilst the quasi stratification of the drift by the waters of the receding glacier has left over the greater part of Staten Island beds of impervious clay. In 1874 a committee of the Richmond County Medical Society reported that "not less than one-half, and in many portions four-fifths of the prevailing diseases are either directly caused or seriously aggravated by the malign influences resulting from insufficient drainage," and subsequent experience affords no ground for modifying this statement.

There are two misleading features about all maps purporting to indicate the topography of endemic disease: First, because greater density of population gives to certain localities an apparent pre-eminence of unhealthfulness; and, second, because domestic insanitary conditions are often the principal, if not the only, factors in the production of miasmatic disorders. Especially is this true of the malarial class of fevers. The chart of Castleton, for instance, being based upon the number of cases of malarial fever reported, necessarily attracts attention chiefly to the thickly settled wards on the shore of New Brighton, whilst some outlying districts wherein the telluric conditions are as bad, or worse, enjoy on paper a seeming immunity, simply because they are very sparsely, or not all, inhabited. On the other hand, in places where the natural environment is least unfavorable, faulty household arrangements may induce, so to speak, an artificial paludal miasm. Decaying vegetable matter in a damp cellar, or soakage of the adjacent soil with "kitchen slops," may effectively imitate in miniature the morbific conditions of natural marsh lands, especially where, as is often the case, furnaces are contrived to carry cellar-air into the upper rooms of houses, creating in addition an indraught of the ground atmosphere laden with the products of decomposition. The not infrequent occurrence of intermittent fever during the depth of winter has in all instances within my observation seemed attributable to sources of the latter kind.

Reference to the map of Castleton (in which alone any registration of disease has been attempted) shows certain groupings of cases, some of which deserve particular mention. In the fourth ward, the lateral soakage of the "Factory Pond," and of the backed-up stream feeding it, has induced saturation of the retention soil for a wide surrounding region; but, beside this, faulty grading of streets and obstruction of natural drainage channels, either by the public authorities, or by private property owners, have held back the surface water in many places. In the absence of sewerage, nearly every house in this thickly populated district has its leaching cess-pool, except where the brook serves as a convenient conduit for house refuse, and a plentiful supply of organic matter is thus instilled into the damp earth. The neighborhood on the south and south-east of thispond, and the adjoining portion of the third ward, show a high "consumption rate," and have also furnished during the past year the greatest number of cases of diphtheria, scarlatina, and diarrhœal disorders.

The settlement at the northern portion of Broadway and Burgher avenue consists, for the most part, of ill-constructed houses, built upon the site of a former alluvial basin, which originally formed the outlet for the surface-drainage of a considerable extent of upland. The filling in of this basin, as I am informed, comprised a large amount of organic rubbish, and the careless habits of many of the residents


VILLAGE OF NEW BRIGHTON,
TOWN OF CASTLETON.
NEW YORK BAY
MIDDLETOWN
CASTLETON
NORTHFIELD
KILL VAN KULL
QUARANTINE LANDING
NEW BRIGHTON LANDING
SNUG HARBOR LANDING
WEST NEW BRIGHTON LANDING
SNUG HARBOR
ST. MARK PL.
RICHMOND
JERSEY ST.
THIRD ST.
FIRST ST.
TERRACE
BARD AVE.
BROADWAY
CLOVE ROAD
ICE PONDS
SILVER L.
JEWETT AVE.
WILLOWBROOK ROAD
∵ Location of Malarial Fevers, 1881.
2d Annual Report, State Board of Health.
T.A.E. BUSTEED, Village Engineer.

augment the pollution of the undrained made-ground. The streets in this neighborhood have been raised, in some instances, several feet, with the result of flooding most of the cellars in rainy seasons. Numerous as are the malarial markings here, and in the previously-described vicinity, it is to be remembered that probably two-thirds of the sufferers from intermittent fever in such a population rely upon patent medicines, or counter-prescribing druggists, instead of consulting a physician, and thus elude medical observation.

In Davis avenue I am assured that malaria is of comparatively recent introduction; its gradual increase has fallen under my own notice. Some years ago the village authorities raised the shore end of the avenue, and filled in the lower part of its declivity to such a height as to destroy its carrying capacity for surface water. This, with the obstruction of a natural drainage-channel, which formerly ran through private property, on the western side of the avenue, has dangerously aggravated the evils of soil-humidity.

A localized endemicity of malarial and septic diseases, in marked contrast with the comparative healthfulness of the surrounding neighborhood, is noticeable in a cluster of cottages between second and third streets, in the Second ward. The ground here is soaked with sewage from cow-yards and stables, privies, and cess-pits; house-refuse and garbage are accumulated on the premises, or cast into the gutters, whilst the street-gradings impede, rather than promote, surface drainage. Diphtheritic and septic fevers have been of frequent occurrence.

These examples are specified as illustrating the proposition that, throughout the built-up portions of New Brighton, malarial conditions are largely of artificial creation. From Tompkinsville to West New Brighton the drift is underlaid by a massive bed of serpentine, with a general north-westerly slope from an altitude of 280 feet to the shore of the Kill-von-Kull, the valleys of undulation in the high-lands affording no impediment to soil-drainage if their courses were respected. There are few, if any, streets wherein the surface water could not be easily deported by proper surface-grading. An ample water supply has recently been introduced by a private company, and it is to be feared that the greatly-increased use of water thus facilitated will, in many places, aggravate the evils of soil saturation until cess-pools are replaced by sewerage.

The picturesque "Clove valley," which forms an outlet from Silver lake (the only natural sheet of water in this region), and from much of the surrounding upland, has been injured by the construction of a chain of artificial ice-ponds, the level of which is alternately raised and lowered. The miasmatic influences thus created have rendered some localities absolutely untenantable.

From the margin of the serpentine westward the town of Northfield is underlaid by triassic sandstone, intersected by a trap-dyke, extending from Port Richmond to the mouth of the Fresh Kills. The general level of this sandstone, interspersed with basin-like depressions, offers a drainage problem of some difficulty throughout the region from Graniteville to Springville.

The districts on the south and east of the belt of gneiss, comprising nearly the whole of the towns of Westfield and Southfield, lie upon cretaceous beds of clays and sands, covered in most parts by drift or alluvial deposit. The marshes along the shores of the Kills and Lower

Bay, composed of silt, clay, and decomposed vegetable matter, are continually receiving fresh accretions from the growth and decay of marine plants.

This brief sketch of the geology of Richmond county, for which I am indebted to an excellent paper by Mr. W. L. Britton [*Ann. N. Y. Acad. Sci.* Vol. II, No. 6.], may serve to explain to a certain extent the widespread existence of the ordinary paludal fevers. Notwithstanding the painstaking researches of many observers and the latest advances of the "germ theory," the primal ætiology of most diseases of the zymotic class is still beyond our ken, and we can do little more than to note the circumstances associated with their development. Most prominent among such circumstances in the case of malarial fevers are the presence of decaying vegetable matter and dampness of soil. Either actual marshes or lands having a substratum of impervious clay or rock with a sandy superficies, are known, the world over, as the most prolific sources of malaria, and both of these abound, not only on Staten Island, but along the borders of the East river and lower part of Long Island Sound, and far up the valley of the Bronx river. In such areas the manifestations are more marked when, as during the past season, a prolonged drought lowers the ground water and exposes for fermentation, layers of organic matter previously submerged. But the presence of malaria in districts where these conditions are apparently lacking, and its reported absence from places where they exist, point to some additional facts, or rather, perhaps, to an ultimate specific cause. Whether the "bacillus malariæ" figured by Klebs and Tommasi-Crudeli will hold a more prominent place in medical literature than Salisbury's "palmella gemiasma," remains to be seen, thus far, the admirable report of Dr. Sternberg to the National Board of Health on this subject, and my own incomplete observations, seem to warrant a provisional Scotch verdict of "not proven." It is, at all events, a matter of common experience that thorough soil-drainage has been effective in abolishing the conditions under which malaria formerly committed its worst ravages in many parts of the country.

The question as to the possible conveyance of the malarial poison by drinking-water is one which cannot be satisfactorily studied where other miasmatic influences are so generally prevalent; nor, for the same reason, can any clear evidence be here adduced respecting the distance of aerial transportation. An apparent increase of paroxysmal fevers has in some places followed the clearing of neighboring woodlands; but whether this has been due chiefly to the removal of foliage-screens, or to the intensification of local agencies by public and private miscalled "improvements" is difficult to determine.

Of the graver endemic maladies associated with malaria, the short time at my disposal has enabled me to make but few local investigations. The past summer and autumn have furnished an unusual number of dysenteric and "typho-malarial" cases; but a study of the origin of these is hampered at the outset by uncertainties of diagnosis and pathology. It is well known that in the severe forms of malarial fever infiltration and suppuration of the follicles of the colon, with other evidences of an intense catarrhal process, have been frequently demonstrated. In the small intestine, hyperæmia commonly exists, and often swelling of the solitary glands and Peyer's patches. Aside from the adynamic type of remittent, which may depend upon unfavorable surroundings or feeble

constitutional powers of resistance, it seems probable that the tendency to intestinal localisation may in some instances render a malarial patient peculiarly susceptible to the infection of true enteric fever; in others, that the glandular implication may simulate the symptoms of a somewhat irregular dothinenteritis, especially when exogenous septic agencies co-operate.

A group of cases illustrating these different types has occurred in a sort of basin at the southern juncture of York avenue and Brighton avenue. The drainage of this neighborhood originally found its way to, and through, the valley of a brook running eastward to the bay; but the processes of grading and filling in have left an altogether insufficient outlet, converting a number of sunken lots into what was formerly popularly known as the "duck pond." A cluster of ill constructed houses inhabited by persons of the poorer class, occupies this unfavorable site, where malarial disorders are perennial. In the lower part of York avenue several cases have occurred in which malarial remittents were ac-accompanied by the phenomena of genuine enteric fever. These cases, arising in different households, have had, as far as I could discover, the common link of drinking water from a certain well on the west side of the avenue, situated on the edge of the sidewalk so that its stonework forms part of the kerb. The sewerage from an adjacent house is discharged through a soil pipe directly into the street-gutter, forming a stagnant pool in front of the well. A sample of the water examined October 27th, was turbid with earthy admixture; contained a small amount of organic matter in solution. and a trace of chlorine (this sample was not analyzed, as it is my custom to make a preliminary test with the old standard solution of potassium per-manganate, and if this be not decolorised within an hour, to make no more minute analysis, except in special cases.) Microscopic examination of the deposit showed, in addition to much mineral matter, amorphous decaying detritus, ciliated infusoria (paramecium, chilodon monas,) numerous micrococci, single or in chains of two or three, and rod-bacteria. Some of the mud from the side of this well, treated as an "artificial marsh," exhibited englera, naricula, etc.; infusoria in myriads; numerous leech-like animalculi, and swarmed with micrococci, chain and rod-bacteria and actively moving bacilla.

Two circumstances are noticeable in this connection: First, that the amount of organic matter revealed by chemical analysis in drinking-water, is not necessarily a measure of its unwholesomeness, the quality (which we have as yet no means of determining) rather than the quantity of pollution, being the essential element of pythogenesis; and, second, that the effects of even highly contaminated water are not alike manifested in all who consume it. Examples abound, on the one hand, of people habitually using with impunity water which the analyst would unhesitatingly condemn, and, on the other, of serious outbreaks of disease unmistakably traceable to water not below the commonly accepted standard of purity. Analytical methods deal chiefly with the products, not the processes, of decomposition; and it is possible that infective microzymes may find conditions for multiplication where the quantity of organic matter is very small. The microscope gives promise of greater future utility in this respect, but in our ignorance of the specific character of micro-organisms its indications are as yet uncertain.

In the instance under consideration, although minor digestive derangements are reported to have been common among the families supplied

by the suspected well, the marked typhoid examples seem, as far as I can learn, to have occurred in persons already suffering from malarial fever.

Another public source of water supply, in this neighborhood, is an open well in a sunken lot, between York avenue and Jersey street, exposed to surface washings of every kind. Ducks, goats and other animals roam at will about its margin, which is not above the level of the surrounding earth. The water from this well, although containing but little dissolved organic matter or chlorine, and without appreciable trace of nitrates, yielded a small deposit of decaying animal and vegetable substances, with numerous filamentous algæ, ciliated infusoria, rod and chain bacteria and bacilli; significant of house washings were borula spores and a few indigo-grains.

Beside the typical enteric cases, apparently confined to five houses in the vicinity of the first-mentioned well, a number of examples of "typho-malarial" fever (ten or twelve, at least, though the returns are incomplete) have occurred in this region. These seem to have been adynamic remittents with, in most cases, intestinal complications; but without the temperature-curves, eruption, or other distinctive signs of true typhoid. The environment of the cases within my knowledge was sufficient to account for both malaria and filth-poisoning. At a small cottage in a cul-de-sac, called Eleventh street, wherein a fatal case had taken place, a leaking cistern, open at the level of the ground and loaded with decaying vegetable matter and surface washings, was close to the rear wall of the house. The basement flooring, laid with open crevices upon the damp earth, was rotten in many spots, and the greater elevation of the ground in front precluded ventilation. The street-gutter was offensively filthy with garbage and house refuse.

In Twelfth street, an adjacent blind alley, three cases had occurred in two houses. On an elevation just in the rear of these was an ill-kept cow-stable, under which was a pool of urine and manure, whilst the washings of the surface filth descended in rivulets upon the premises below. Not far from here, on Brighton avenue, where three other cases had arisen, was another cow-stable, containing fourteen cows, soakage from which leaked toward the infected houses. Under this stable was a foul lake of urine and drippings, the outflow from which trickled across the sidewalk into the street gutter, which also served as a receptacle for household refuse. A filthy stable-yard and shed were immediately in the rear of these premises and upon higher ground. In the neighborhood thus described sporadic cases of diphtheria have arisen for several years past, and scarlatina is now reported to exist.

Along the northern declivity of Jersey street the sanitary conditions are extremely bad. This is the most densely populated part of New Brighton, many of the tenements being occupied by different families on each floor. Surface-washing and soakage from privies and cess-pools on the higher ground of York avenue have for years been saturating the soil on its western side, and to the general pollution it contributes a number of its own foul, and sometimes overflowing privy vaults. In addition the sewage from almost every house is discharged through pipes emptying directly into the street gutter. Very recently the street was macademized, and the gutters relaid; but in the new kerbing openings were made to give exit to these house-drains, in violation of a village ordinance, as well as of a regulation of the Board of Health.

In the lower portion of the eastern side of Jersey street the outlet from a small factory pond passes through the cellars of a row of houses, receiving the sewage and excreta of each in its course. Through untrapped privy-seats, and other house-openings into this foul trench its sickening effluvia have egress into the apartments above. Scarlatina, diphtheria, typhoid, erysipelas, pernicious intermittent, and cerebrospinal fever have occurred at intervals along this thoroughfare, and the consumption rate is high.

A localized endemic of typhoid fever at Mariner's Harbor (where, in a small group of houses, cases have arisen at intervals for two or three years past), is connected with excremental pollution of a well used in common. Three privy-pits are within easy leaching distance of this well, the water of which is loaded with organic matter and chlorine. I can learn of no importation of the disease, which seems to have been of local pythogenic origin.

"Typho-malarial" and adynamic remittent fevers, interspersed with cases of true typhoid, have arisen along the line of the "Port Richmond Ditch," a foul conduit, receiving the sewage and excreta from a number of houses in a populous neighborhood. Many of the houses have direct communication with this ditch through inside water-closets, diphtheria and filth diseases of various kinds have frequently shown themselves here.

About the more sparsely-built settlements at and near Springville and Long Neck, the proximity of the vast alluvial marshes, and the general saturation of the low-lying meadow land sufficiently account for the prevalence of severe and intractable paludal fevers and chronic malarial toxæmia. Scattered cases of enteric fever in these districts have, in all instances which could be investigated, seemed attributable to excremental pollution of well-water from adjacent privy-pits. Such cases have been of annual occurrence for some years past, and I cannot learn that their frequency during the present year has been more than proportionate to the increase of population.

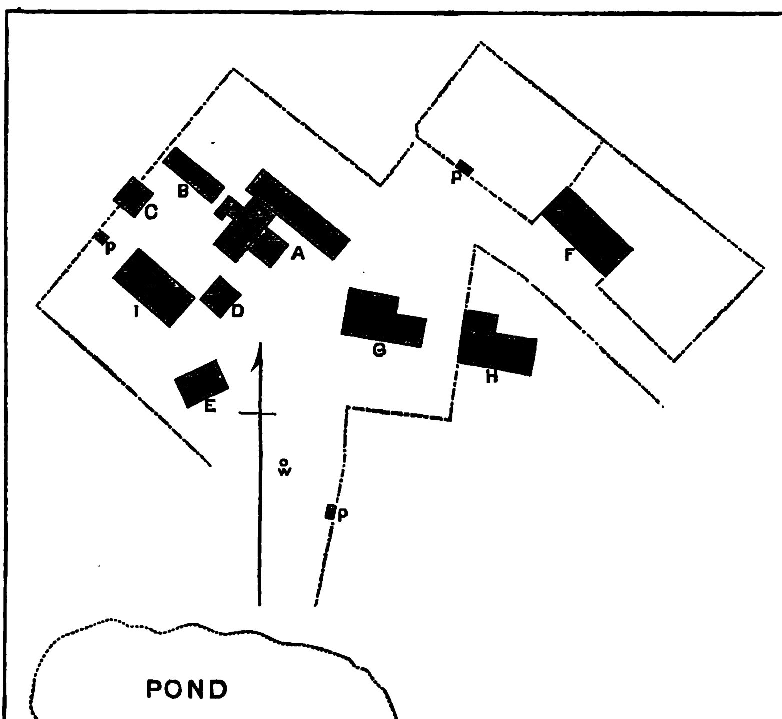
The relation between the fluctuations of the ground-water and outbreaks of typhoid, observed by Pettenkofer at Munich, has not held good in many other places. It is only where the ground-water level serves as an index of the moisture of the superficial strata of soil that such pathogenetic correspondence is verified, and for most practical purposes, in this respect, sanitary geology might terminate with the first impermeable stratum. Over the greater part of Staten Island this retentive layer is very near the surface, and alternate submergence and exposure to decomposition of superposed organic substances may be caused by transient conditions of surface evaporation or slight rainfall, which could have little effect upon the deeper water-level.

A reported epidemic of typhoid fever at Mr. Tysen's canning factory, near New Dorp, to which much notoriety was given by newspaper articles, has been made the subject of special investigation. The factory and accessary buildings are situated upon a knoll about sixteen feet above the surrounding flat-land, the total elevation above sea-level being about twenty-five feet. This part of the town of Southfield lies beyond the margin of the glacial drift, immediately upon a cretaceous bed of tenacious clay, underlaid by sand. The average depth to ground-water is about twenty-two feet. Extensive alluvial marshes reach from the Lower Bay to within a short distance of the premises.

A few rods from the base of the knoll is a pond, which receives the drainage and effluent water from the factory, containing much vegetable matter in suspension. In such a situation all the conditions for malaria are present, and through that region of country intermittents and remittents have long been common, more than ever prevalent during the past summer and autumn, and often assuming an adynamic type or complicated with dysenteric symptoms. Three cases of typhoid fever are reported to have occurred in the summer of 1880 in the neighborhood of New Dorp, but none upon or near the factory grounds until this year.

The accompanying diagram, made by Mr. T. A. E. Busteed, engineer of New Brighton, shows the relative positions of the buildings occupied by Mr. Tysen, who employs from 150 to 200 hands during two months of the year; the number varying with the exigencies of the season, which ends with the first frost. Many of these are men who return year after year; others are engaged as unskilled laborers for short periods, sometimes from employment agencies, oftener, as I am informed, on their voluntary application. No children are employed, and but two women.

The sleeping quarters are in the upper story of the farm-house, in the



loft over the dining room, and in a special loft raised upon joists about eight feet above the ground. This year, I am told, a number of extra hands were temporarily engaged, who slept in the hay-loft over the barn.

The smallest of these lofts (I) afforded about 250 cubic feet per head for fifty men (the greatest number, I am assurred, ever occupying it), and its aggregate air-opening — four windows, entrance gangway, and roof ventilators — would allow a movement of from 5,000 to 6,000 cubic feet per minute with a velocity of one and one-half feet per second. The disposal of excreta is by means of shallow privy trenches, the seats being open at the back so as to give free ventilation. Carbolic acid is sprinkled about and the excrement covered daily with dry earth, the compost being removed at intervals to the manure heap, of the barnyard. These privies are at the base of the knoll, on lower ground than any of the inhabited buildings. It has, however, as I learn, been common among some of the men, especially at night, to ease themselves anywhere about the premises. The water-supply is from a well under the factory roof, and is exceptionally pure. The fare seems to have been ample in quantity and, as far as I can gather from the preponderance of somewhat conflicting testimony, reasonably good in quality. On the one hand, eight or ten of the patients whom I saw at the Ward's Island Hospital found fault with the kind and cooking of their food at New Dorp, and, on the other hand, I have the depositions of between fifty and sixty of Mr. Tysen's workmen and neighbors as to the abundance of fresh provisions. At the time of my own visits the table was plentifully supplied.

The only grave sanitary defect upon the premises lay in the sleeping arrangements. Bunks, separated by board partitions on the floor of the above described lofts, were filled with straw covered by blankets; and this bedding was left unchanged for weeks, soiled sometimes by the carelessness of the occupants. Many of the transient hands have been of the poorest class of immigrants, dirty in their personal habits and destitute in their circumstances; fitting subjects for severe malarial attacks under the vicissitudes of weather to which their work necessarily exposes them. The sudden transition from privation to full diet, aided in some instances by over indulgence in beer, has rendered diarrhœal disturbances common among these new comers, and increased the difficulty of tracing more serious disease to its origin.

From Dr. Millspaugh, Mr. Tysen's medical adviser, I learn that until the present year no graver illness than ordinary malarial fever has arisen among the men employed; that, this summer, cases were more frequent, "mostly simple intermittents, a few remittents of a somewhat severe type, and still fewer running into a low malignant typhoidal form, with some abdominal tenderness, red and dry tongues, delirium, etc." But one case of dysentery was seen by Dr. Millspaugh on the premises. No instance of marked enteric fever came to his notice until the latter part of August; but the importation of the infection seems to have been due to one of two immigrants who came to the factory on July 22, homeless and penniless. Both of these men are described as suffering on their arrival from languor, diarrhœa, and feverishness, unable to do a full day's work, and they made but a brief stay. I have been unable to acertain any thing more definite of their history than that one of them had been lodging in casual Greenwich street cellars, and that the other came from the lower part of Orchard street. I am informed by Dr. Nagle, of the New York Bureau of Vital Statistics, that typhoid fever existed at 73 Orchard street.

In the early part of August a man who had been on the place and in

good health for three months was taken with lassitude, fever, diarrhœa, in short, from his own account, with all the symptoms of "walking typhoid," but continued at his work for a fortnight or more, and was only confined to his bed for about a week. This patient's step-brother, who slept next him, sickened soon afterward, and his case being (the first) recognized as typhoid, he was removed to the county hospital, where he died September 11th. Four other cases arose at brief intervals. One was admitted to the Smith Infirmary where he died of undoubted typhoid; the others were treated on the premises and recovered. These latter Dr. Millspaugh regarded as adynamic remittent rather than true enteric fever. One man is still ill at the county hospital with adynamic remittent.

At the State Emigrant Hospital 28 patients have been received who had worked at Mr. Tysen's factory, the dates of admission ranging from September 8 to November 15. Of these there were six cases of enteric fever with four deaths, admitted between September 8 and October 29; one doubtful, complicated with measles, on September 13; four of dysentery, with one death, between September 20 and October 29; the remainder (none fatal) being malarial fevers, ranging from simple intermittent to adynamic remittent or quasi continued.

As far as I have been able to localize the cases (starting from the assumed importation on July 22) the first three occurred in loft I; the fourth in loft H; the fifth in the hay-loft F; the sixth in the farmhouse G; the seventh in loft I; the eighth in loft H; the ninth in the hay-loft; the others (being either dead or discharged from Ward's Island) could not be traced. Among so many men closely quartered together and negligent of cleanliness, their clothing and bedding often soiled with excreta, the extension of the disease is easily accounted for; indeed, it is rather surprising that the epidemic was of such limited character. On the occasion of my first visit, on November 12, I found one man with the commencing eruption of confluent small-pox. He was, as soon as practicable, removed by order of health officer Clark, of Southfield, to the isolation hospital at the poor-house where he died three days afterward. No subsequent cases have been reported. This patient had arrived ten days before I saw him, from 32 Greenwich street, at which place I learn from the records of the New York Health Department that four other cases of small-pox had been discovered between October 28 and November 4. In view of the dangerous part taken by lodging-houses of this sort in the dissemination of variola, I would urge the importance of thorough vaccination of all immigrants before landing. This could be done at Castle Garden as regards persons who have not been detained at quarantine.

An outbreak of diphtheria among children attending one of the public schools was recently brought to the notice of the New Brighton Board of Health. The first case occurred on November 1st, in the person of a girl who had not, as far as could be learned, been exposed to any other source of infection, and whose home surroundings were free from sanitary defects. No previous cases had been reported in the neighborhood. On November 16, three cases were reported in another neighborhood; two on the 18th; two on the 22d; one on the 23d. All these children were pupils of the school, and all except one were in the same room. Mr. Clarence Barrett was requested, as an expert, to examine the premises and reported as follows:

To the Honorable Board of Health of New Brighton:

GENTLEMEN:—In compliance with your request I examined, on the 29th inst., the buildings and grounds of District School No. 4, Castleton, and found the following sanitary defects:

1. No provisions have been made whatever for the ventilation of the basement and first floor of building, and the same can be said of the second or upper story, with the exception of a shaft leading above the roof from one room and hall. This shaft only opens to the north and south. In some of the rooms there are less than 225 cubic feet of air to each occupant.

2. A part of the basement (which is damp) is occupied as living apartments by the janitor; the odors of cooking and the foul air of these sleeping rooms pass through the halls into the school rooms above.

3. The heating furnaces (two in number) are supplied with fresh air from the north side of the building only. And the one in use in the easterly end of the building takes air also from a room in the basement which is occupied as a sleeping room.

4. Water closets (pans) closely encased and emptying into a horizontal pipe placed under the floor. These closets are without any ventilation, are improperly flushed, the inner chambers are foul, and the odors and gases from them must pass up the stairway into the building.

5. On the east end of the building there is attached a small building furnished with hopper closets, which are used by the scholars. This building is not properly ventilated and the water supply (which is ample) is not arranged so as to keep them clean or remove the filth from each bowl and drain.

6. The storm water from the roof is carried under ground, and I am informed supplies cisterns which overflow into the sewer. And I am also informed that there are three old cesspools which are not in use and which have not been cleaned or disinfected. I could not, without uncovering these cisterns and cesspools as well as their connections, say positively that such is the case. Yours respectfully,

C. T. BARRETT.

WEST NEW BRIGHTON, 30*th Nov.*, '81.

Two years ago diphtheria was alleged to have originated in the same school, and I then reported [Trans. N. Y. State Med. Soc., 1879, p. 536] that:

"A fatal defect in this building lies in the arrangement of the water closets and urinals, which are placed in the basement, connecting with a cesspool about 50 feet from the house; there is no provisions for ventilating the waste-pipes, and the escape of malodorous gases from the closets is very offensive. Stairs leading from these closets to the school room floor invite the ascent of noxious vapors to the upper part of the building, especially in winter when the artificially warmed inner air creates an upward draught; moreover, to make matters worse, a hot-air flue from the furnace passes through the ceiling of the boys' water closet into a school room directly overhead."

The result of numerous investigations has been to convince me that excremental pollutions of air or water is the most frequent source of diphtheria. In thinly inhabited districts, where it was possible to exclude any importation by persons or fomites, I have repeatedly seen the

disease arising when one of these two factors afforded the only possible explanation of its origin. A marked illustration of its connection with impure drinking water happened in an isolated house at Castleton Corners wherein fifteen children from the nursery and child's hospital were boarded. Between June 4 and 7 nine cases of diphtheria appeared in this household. On careful inspection no insanitary conditions could be found save in the well water, which bore evidence of sewage contamination. Cistern water was substituted, and no new sickness arose until the beginning of August, when the cistern became exhausted and a recurrence to the well was followed by a severe case of diphtheria and several of pharyngitis. Instructions were given to boil the water before using it and since then no fresh cases have occurred.*

The village trustees of Edgewater, having discovered that their charter confers upon them the powers of a board of health, not only refuse, despite the solicitations of a committee of the Richmond County Medical Society, to fulfill the requirements of the State act, but resist the interference of the town Board of Health. The village is thus without any pretense of efficient sanitary organization; without even the nominal appointment of a health officer; and no measures seem likely to be taken to abate many conditions in the highest degree detrimental to health. No registration of deaths or diseases is made, but from personal inquiry I have learned of the prevalence of typhoid and diphtheria in several localities, especially in the undrained and filth sodden district about Gore and Gowden streets at Stapleton. This district and other insalubrious features of Edgewater were described in the report of the Metropolitan Board of Health for 1869, since when few of the evils then existing have been rectified, whilst others have been created with the increase of population. In one place an open trench, bearing the surface washing from the adjoining high ground of Castleton and receiving sewage from a pig sty and privy on its way, is carried under the Richmond road and continued through the yards of the opposite houses, within a few feet of the windows, its stench being very offensive. Two cases of typhoid fever and one of diphtheria have occurred within a fortnight in one household on the line of this branch, and I am informed that other cases have occurred in the vicinity.

In concluding this incomplete and necessarily desultory recital of the few sources of endemic disease which have thus far come within my observation, I have only to reiterate what has again and again been taught: that such sickness and death belong to the preventable class, and that the expenditure needed for their prevention would be the most profitable of investments. The impediments to sanitation on Staten Island are nowhere insuperable; indeed, in the most mischievous examples they are of human invention. The household is, of course, the starting point of all sanitary improvement, and until the people at large can be educated in the principles of home hygiene, there will always be scattered instances of illness from domestic causes. But all precautions of the householder are in vain unless the external conditions of public health be provided; and these require, in the built up portions of the villages, sewerage, and, everywhere, attention to soil-

*An account of this and other groups of diphtheria in which exposure to contagion bore no part will be found in a paper by Dr. M. A. Avery, of the Nursery and Child's Hospital, read before the Staten Island Clinical Society.

drainage. In respect of the latter desideratum, to reconcile the separate and sometimes conflicting autonomies of contiguous townships and villages, as well as to prevent further detriment from injudicious public or private operations, the intervention of the State Board of Health — at least in an advisory capacity — might be of the utmost benefit, by determining and defining the natural drainage channels which it is necessary to preserve in all future grading. Most of the topographical data for such a scheme are already accessible, and the few additional surveys needed could be obtained without much expense.

Investigation Concerning Causes of an Outbreak of Fever and Dysentery at New Dorp, Staten Island.

The following communication from the Commissioners of Emigration was referred to the State Board of Health by request of the Health Department of the city of New York, and as it was immediately brought under Dr. Carroll's study, his report follows the original complaint made by the Commissioners of Emigration:

November 11th, 1871.

To the Commissioners of the Health Department:

Gentlemen: — I am directed by the Commissioners of Emigration to lay before your honorable Board the following extracts from a report made by Dr. Schultze, physician at the State Emigrant Hospital, Ward's Island, in reference to the unhealthy condition of the tomatoe canning factory situated at New Dorp, Staten Island, and to request that you will take action thereon:

"Mr. Tysen employs during the months of August and September about 200 men, recently arrived immigrants, mostly and principally Germans who do not understand the language. Within the past two months we have received into this hospital from 40 to 50 men who had been employed at Tysen's factory. At present we have of these 30 patients who are under treatment, some suffering from typhoid fever and others from dysentery in its severest form. The patients all complain bitterly of the treatment they received. Four patients recently died here who took the fever at the factory."

Very respectfully,
H. J. JACKSON, *Secretary.*

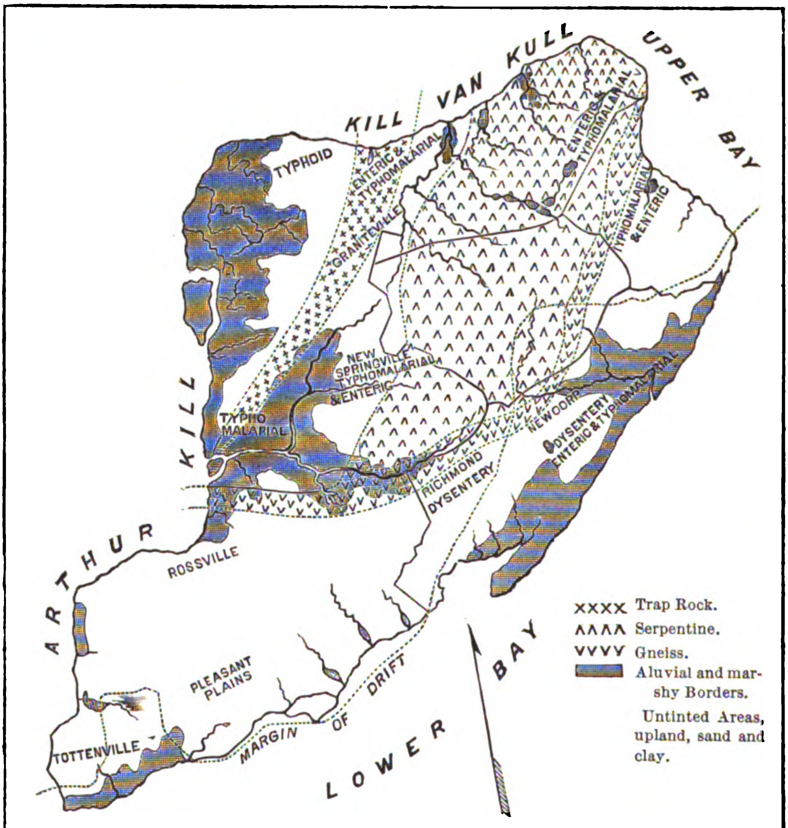
Dr. Carroll's Report.

To Secretary State Board of Health:

Dear Sir: — Respecting the alleged outbreak of pythogenic fever at Mr. Tysen's canning factory at New Dorp, Staten Island, my inquiries have been beset by many difficulties and delays, owing to the dispersion of most of the operatives at the end of the business season, which terminates with the first frost; and my investigation is not yet so complete as I hope soon to make it. From the facts already in my possession, however, I feel warranted in presenting the following brief preliminary report:

The cluster of buildings used by Mr. Tysen stands upon a small knoll about sixteen feet above the surrounding flat land, the total elevation above sea level being about 25 feet. This portion of the town of

Southfield lies beyond the margin of the glacial drift, immediately upon a cretaceous bed of tenacious clay underlaid by sand. Extensive



Geology of Richmond county.

alluvial marshes, reach from the Lower Bay to within a short distance of the premises. A few rods from the base of the knoll is a pond which receives the drainage and effluent water from the factory, containing much vegetable matter in suspension. In such a situation all the conditions for malaria are present, and through all that region of country malarial fevers have long been common; more than ever prevalent during the past summer and autumn, and often assuming an adynamic type or complicated with dysenteric symptoms.

On Mr. Tysen's place from 150 to 200 hands are employed during two months during each year, the number varying with the exigencies of the season. Many of these are men who return year after year; others are engaged as unskilled laborers for short periods, sometimes from employment agencies, oftener, as I am informed, on voluntary application. No children are employed, and but two women.

The sleeping quarters are in the upper story of the farm house, in the

loft over the dining room, and in a special loft raised upon poles about 8 feet above the ground. This year, I am told, an extra number of men were temporarily employed, who slept in the hay-loft over the barn. The smallest of these sleeping-lofts afforded about 250 cubic feet per head if containing fifty men (the greatest number, I am assured ever occupying it), and its aggregate air openings would allow a movement of from 5,000 to 6,000 cubic feet of air per minute with a velocity of one and one-half feet per second.

Many of the transient hands have been of the poorest class of immigrants, dirty in their personal habits and destitute in their circumstances; poorly clad and half starved on their arrival, and fitting subjects for severe malarial attacks under the vicissitudes of weather to which their work necessarily exposes them. The sudden change from privation to full diet, aided in some instances by over indulgence in beer, has rendered diarrhœal disturbances common among these new comers, and increased the difficulty of tracing more serious disease to its origin.

The disposal of excreta is by means of three shallow privy-trenches, the seats being open at the back so as to give free ventilation. Carbolic acid is freely used, and the excrement covered daily with dry earth, the compost being removed at intervals to the manure heap of the barn yard. These privies are at the base of the knoll, sufficiently distant from the inhabited buildings. It has, however, as I learn, been common among some of the men, especially at night, to void themselves anywhere about the grounds.

The water-supply is from a well under the factory roof, and is exceptionally pure. The fare seems to have been ample in quantity and, as far as I can gather from the preponderance of somewhat conflicting testimony, reasonably good in quality.

The only markedly insanitary condition, aside from the personal uncleanliness of many of the men, lay in the bedding arrangements. Bunks, separated by board partitions on the floor of the above described lofts, were filled with straw covered by blankets, and this bedding was left unchanged for weeks, soiled sometimes by the carelessness of the occupants.

From Dr. Millspaugh, Mr. Tysen's medical adviser, I learn that until the present year no graver illness than ordinary malarial fever has occurred among the men employed. This summer, there as elsewhere, cases were more frequent "mostly simple intermittents, a few remittents of a somewhat severe type, and still fewer running into a low malignant, typhoidal form, with some abdominal tenderness, red and dry tongues, delirium, etc." But one case of dysentery was seen by Dr. Millspaugh on the premises, though this and diarrhœa have been prevalent throughout all that section of country. Two deaths from enteric fever (the first on September 11th) and one from small-pox comprise the mortality among the employes here. One man is reported convalescing from what appears to have been a mild and unrecognized typhoid, and another is still ill at the county hospital with adynamic remittent.

The importation of the specific typhoid and infection seems to be due to two immigrants who came down to the factory on July 22, homeless and penniless. Both of these men were suffering with languor,

diarrhœa, and feverishness, unable to do a full day's work, and made but a brief stay. One of them had lodged in casual Greenwich street cellars, the other in Orchard street. These cases I am endeavoring to trace more definitely. In the early part of August another man, who had been on the place for three months, was taken with diarrhœa, lassitude, fever, in short, from his own account, with all the symptoms of "walking typhoid." He continued at his work, however, for a fortnight or more, and was only confined to his bed for about a week. This patient's step-brother, who slept with him, sickened next, and his case being recognized as typhoid he was removed to the county hospital, where he died on September 11th. Four other cases arose at brief intervals. One was admitted to the Smith Infirmary where he died of undoubted typhoid; the others were treated on the premises and recovered. These Dr. Millspaugh is inclined to regard as adynamic remittent rather than true enteric.

At the State Emigrant Hospital 28 patients have been received who had worked at Mr. Tysen's factory, the dates of admission ranging from September 8th to November 15th. Of these there were six cases of enteric fever with four deaths, admitted between September 8th and October 29th; one doubtful, complicated with measles, on September 13th; four of dysentery, with one death, between September 20th and October 29th; the remainder (none fatal) being malarial fevers, ranging from simple intermittent to adynamic remittent or quasi continued.

All the cases and dates of enteric fever thus obtained conform with the opinion that the infection was imported on the 22d of July. Its extension is easily accounted for by the soiling of bedding and clothing with typhoid excreta; indeed, it is surprising that so few cases should have occurred among so many men closely quartered together, and negligent of cleanliness, and the limited character of the outbreak argues against local pythogenesis.

On the occasion of my first visit, on November 12th, I found one man showing the commencing eruptions of confluent small-pox. He was, as soon as practicable, removed by order of health officer Clark, of Smithfield, to the isolation hospital at the poor-house, where he died three days afterwards, and fumigation and vaccination were practiced by Dr. Millspaugh. No subsequent cases had occurred up to the 26th inst. This patient had arrived ten days before I saw him, from lodgings at 32 Greenwich street. From inquiries which I have made as to the dissemination of small-pox through such lodging houses, I am led to urge the importance of having a vaccinating station at Castle Garden, where every immigrant can be protected on landing. As it is, many unvaccinated persons are necessarily passed through the quarantine department without detention.

Further and more exact data will be given in a more detailed report which I hope to forward in a few days, when I shall have examined the suspected sources of infection.

I have the honor to be, sir,

Your obedient servant,

ALFRED D. CARROLL, M. D.

WEST NEW BRIGHTON, *Nov.* 29, 1881.

Spontaneous Outbreaks of Typhoid Fever in a Mountain District of Essex and Warren Counties.

The following brief account is contributed by Dr. Cooley, who ascertained the facts while upon his investigation of diphtheria in Schroon, Johnsburgh and Minerva.

James Ford occupied, with his family of eight, a house in a low, swampy place near the former site of a tannery, burned a few years since. The well, from which water is procured for use by the family, is in the woodshed attached to the house. The slops are thrown upon the ground back of the well, and the privy is some three or four rods distant from the well. The cases of fever in this family were as follows:

Michael,	aged 21,	taken	Sept.	8, 1880,	recovered.
Maggie,	" 16,	"	Dec.	1, "	died in 10 days.
John,	" 18,	"	Jan.	8, 1881,	recovered.
Mrs. Ford,	" 45,	"	"	21, "	"
James,	" 8,	"	"	22 or 23, 1881,	recovered.

The source of the trouble in the case of Michael is unknown at present. The unsanitary surroundings of the premises leave little room for doubt that the others contracted the disease in consequence of the first case. These facts are due to Dr. J. C. Wall, of Olmsteadville, who attended the family.

Typhoid Fever in Johnsburg:—Dr G. R. Martine reports eighteen cases of typhoid fever in 1881. All were not well marked, but all had more or less of the typhoid symptoms and were of long duration. No two of the cases were in the same house, and no cause has, as yet, been ascertained for the attacks. Both sexes and all ages from 4 to 36 years of age, and in one case of 60 years, had the fever. The number of deaths was four (4). Most of the families where these cases occurred obtained their water from wells, and the dwellings were situated from 20 to 100 feet above the bottom of the valley. In no case was there any thing certain that would indicate a propagation of the disease from one to another, and as but one case occurred in a house, they were all probably idiopathic.

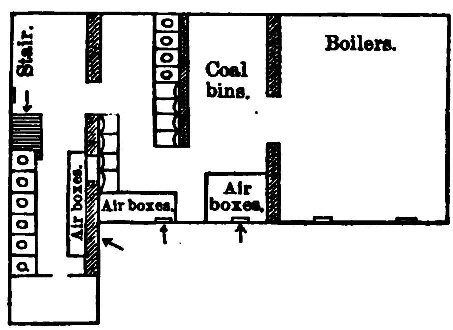
Respectfully submitted,

JAMES S. COOLEY, M. D.

LUZERNE, N. Y., *Jan.* 19, 1882.

means of egress by the stair into the corridor, and through cracks in the air boxes into the school-room. The closets were not offensive at nine in the morning, having been washed out since the last session; but after a few of the boys had been down, by ten and a quarter they became decidedly offensive. They make a hideous rattling noise while the water is running. The urinals throw a jet of spray forward in a threatening way, compelling the boys to stand back; the floor is therefore used instead. They are all at the same height from the floor (21") so that it is impossible for small boys to use them. A ventilating aperture in the boys' department draws, but does not much relieve the nuisance. In the girls' side a bell trap in the cemented floor gives exit to the water used in washing down; it allows gases to return from sewer.

Diagram of part of cellar, School No. 10, Rochester, showing proximity of air supply to 10 water closets and 8 urinals.



No. 12 has a cellar divided longitudinally by a wall into two parts, with access from corriders, one for each sex. At the far end of each part are water-closets with no special ventilation, not well lighted, and not very sweet.

No. 13 has nine water-closets for boys in cellar, in a room with heavy walls, entered from outside by a porch and steps; a door shuts it out from the cellar. It is rather dark. The bell-trap in the floor gives a current of air both ways. The girls' water-closet is isolated similarly, except that it is entered by a stair from the corridor. It has one window which is nailed open.

No. 19 has in the cellar eight disused water-closets not disconnected; the privy in yard is used instead. A pipe from one of the urinals in cellar is burst.

No. 20 has in the cellar a disused water tank, the overflow pipe from which has a strong inward draught—perhaps from some sewer; it runs through the wall of the house.

Privies.— Sixteen schools in Rochester depend on the use of privies. These are not at all in a uniform state. No. 15 has one brick house for each sex, widely separated, with a board fence in addition between, and over a hundred feet from the house; they are in good condition and have only such odor as is inseparable from the use of a vault in that manner. The only serious objection that occurred to me in inspecting it was the exposure to the weather. This is a fault common to all; it is of course objectionable to bring the building near the school-house

conveniences, cellars, general care of house, nuisances in or about the house.

6. State of repair and safety.
7. Wardrobes, water supply and personal cleanliness.
8. School hours, recesses, gymnastics, singing.
9. Customs or rules observed in regard to the prevention of contagious diseases, and to vaccination.
10. Plans for school-houses have been criticised in another statement, herewith submitted by Dr. Lincoln, in which certain general principles bearing upon light and ventilation are given in detail. The reader is referred to that paper for various matters which do not so appropriately find a place in the present.

[No. 35.]

STATE BOARD OF HEALTH OF NEW YORK.

SCHOOL BUILDINGS, AND THE HYGIENE OF PUBLIC SCHOOLS.

The State Board of Health, having directed its committee on Public Institutions to issue a circular and make inquiries in regard to the condition and wants of public school buildings, invites attention to this subject throughout the State; and with the design of obtaining useful information the following points of inquiry are respectfully submitted:

1. What is the number of pupils registered as attending the public schools to which this report relates? Mention these schools by name, or number, according as they are known by your School Board.
2. What is the total number of seats, or the seating capacity, in the study-rooms of each school-house here mentioned?

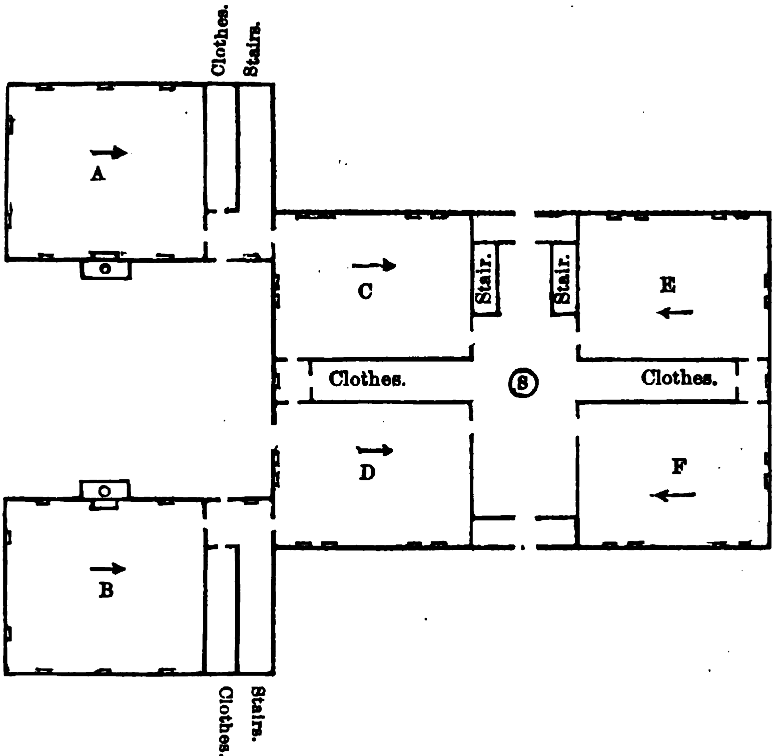
SUN LIGHTING.

3. State, under the name of each school-house, the dimensions of each of the study-rooms, and each of the recitation-rooms, which it contains (length, width, height).
4. On what side or sides of each room (north, south, etc.) are the windows?
5. Is the light in front of, at the right of, at the left of, or behind, the pupils, in each case?
6. Is the light abundant?
7. How near to the ceiling and to the floor do the windows extend?

VENTILATION.

8. How are the rooms ventilated? In how many of them are there open fireplaces?
9. In how many of them do the windows open both at top and bottom? or are provided with transom opening? or are specially arranged (and how) for ventilation?

SCHOOL-HOUSE NO. 4, ROCHESTER. (1st story.)



The portion A B. is new, C D E F is old. The new rooms in each story measure 31′ by 22′ 5″ The old rooms measure twenty-two and one-half feet in breadth, and from 29½′–32′ in height. These proportions are good. The first story is 13′9½″ in height. The second is 13′10″ the third is 17′ 2.″ The upper stories resemble the lower in plan.

The windows in room C are six in number, eight feet high, twenty-eight inches across the glass exclusive of sash. This gives 112 square feet of glass, which is a little over one-sixth of the floor-space. There are about two feet of space between the glass and the ceiling. Transoms are placed over the room doors.

Taking the entire house, the floor-space of the class-rooms equals about 12,700 square feet. This divided among 718, the number of seats, allows 17.7 square feet on an average to each desk and seat. Somewhat more space is desirable.

There is an average attendance of about 750. Some rooms are overfilled. Room C had 48 *seats* and 61 *pupils*, which gives about 150 cubic feet of space per head. For three weeks, before a better distribution was made, there were in this room seventy pupils, very young scholars. Another room presents an example of really reprehensible crowding. It registers thirty-five pupils of the youngest grade. Its dimensions are only seventeen feet six inches by ten feet, ten inches, and thirteen and three-

quarter feet in height, giving *a cubic capacity of about seventy cubie feet per head.* This room is situated at the south end of the second story corridor, which should have been left free. *It has no means of ventilation except by opening the transom at one end and the window at the other*, which gives an insupportable draught.

The rooms are heated by a stove in each, properly guarded by a sheet-iron screen. Each of the old rooms has a ventilating aperture of moderate size at the floor and one over it at the ceiling, the draught in which was found irregular and weak, since *one and the same flue* of the size of eighteen and a half by ten and a half inches *is expected to do the work for three rooms, one over the other.* In many of the rooms *the apertures were closed.* The flues extend to the cellar. The cellar opening to one of them was found uncapped, the cover having rusted away (?).

The new rooms ventilate by a register (eighteen and one-half by eleven and one-half inches) at the floor level, to a brick shaft two feet four inches by three feet eight inches, inside, which contains a ten-inch cast iron flue into which the stoves of the room discharge smoke. The draught was good. In all of the rooms, however, *there is wanting a provision for introducing the air* as well as taking it out; but the stoves are soon to be superseded by heaters in the cellar. The air of the house varies but is usually not perfectly fresh. Windows are often open and in fact are almost entirely relied upon.

A part of the upper *corridor is walled off* and entered by flap doors. This space is used as a recitation room. It is *dark and close* and smelt of gas from a stove.

The clothes rooms are wide open to the corridors, but the windows at the farther end were shut. They were quite *close.*

The room for the seventh grade had *seats* suitable for the sixth (seats fourteen and a half inches high) so that twenty-three of the scholars actually using them did not rest their feet upon the floor when they let them hang down.

Some experiments made in 1877 in ten of the rooms of the older building resulted in statements which may be summed up as follows: A supply of 750,000 cubic feet of air per hour being required, the actual exhaust of air was 107,000 cubic feet. (Report of the Health Officer of city of Rochester, 1878.)

On each floor there are three three-quarter inch hose bibs and 100 feet of hose within easy access. The hose is school property. There are four points of egress, *the doors opening inwards.* The floors are laid in two inches of mortar except the lower floor of the north wing.

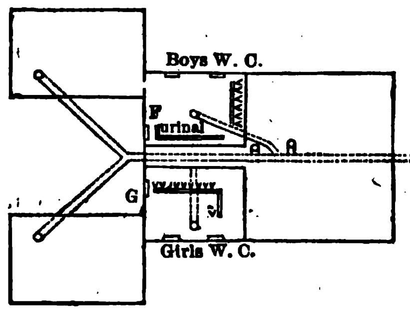
The corridors are spacious. The staircase in the old building is in two parts, meeting half-way at a landing and reversing its direction. It is sufficient and not very steep. With the free communication that exists between the rooms, escape in case of fire is sufficiently provided for.

There seems to be enough light in the rooms. C, for example, although the rear light is rather poor, is well lighted from the sides. As is universally the practice in this city, the children *sit facing in, a direction determined only by convenience of administration*, and hence often receive the light in directions not quite desirable. The arrows on the plan indicate the way the children face. *Black-boards* are placed without reference to the position of windows.

The result of a similar testing of the new rooms would doubtless be more favorable.

The drainage and sewerage is illustrated in the annexed plan of the cellar. The circles represent openings in the floor. The water-closets are entered from the wings, and there is no door at that end of the water-closet rooms. The door at the eastern end of the room is closed to maintain the separation of the sexes.

SCHOOL-HOUSE NO. 4, ROCHESTER. (Cellar.)



The openings in the cellar floor are secured by *bell traps*. These are further secured by running traps in the wings. That in the north wing was found to emit a current of air having *a very decided sewer smell.* Those in the girls' and boys' closets are kept filled by the daily swabbing of their cemented floors. Those in the center of the main cellar receive the discharge from the six drinking places of the old building and one private urinal up stairs; disconnection is made, the water dropping in sight from a lead pipe upon the bell trap in the floor. These wash places are trapped but the urinal is not.

There is thus in the cellar a long tract of drain bearing matter from the water-closets in which a current of air *may at any time* (especially in cold weather) *set back and force some of the traps.* The simple upward suction of the house air tends to do the same.

The drain under the boys' water-closet is flushed by the rain water from the roof led in at the end next the cellar wall. The urinal receives at its upper end the waste water from three drinking faucets in the north wing, the troughs to which are tapped. The girls' water-closets are also flushed by the waste water from three faucets in the south wing, but in this case *the sewer is connected directly with the waste pipe* (at g), *and only one of the three faucets is trapped.*

The water-closets are hoppers acting automatically with an S trap, which *constantly gets full of foecal discharges*, and has to be poked out with a short broom.

The urinal is a trough of galvanized iron, with a perforated pipe at its border which discharges small streams of water.

Very little offensive odor was noticed. The two rooms in the cellar are unusually well lighted. Each, however, *communicates pretty directly with a space between two school-rooms.*

There is a wooden floor under the water-closets, and *the space underneath is inaccessible*, it is doubtless becoming more and more offensive.

It cannot be called a nuisance of the first order though decidedly objectionable.

The boys' water-closets are properly left without doors. The *main soil pipe is not trapped* before entering the sewer, *none of the traps are ventilated*. It is true that the wastes from the house need not be directly connected with the sewer (as in the case of the girls' closets), but still the traps are liable to be syphoned out in several places.

DISTRICT SCHOOLS IN THE COUNTRY AND VILLAGES.

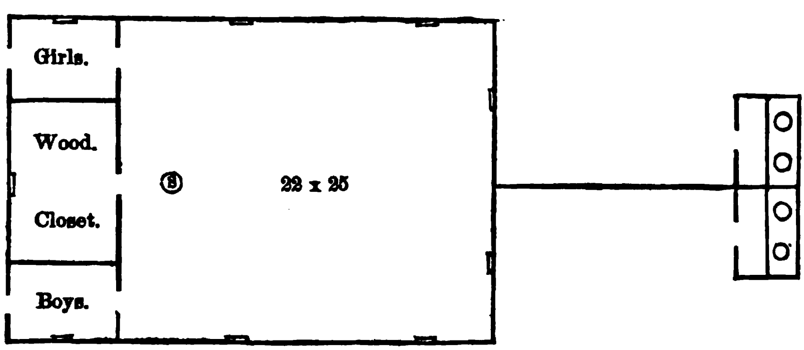
Number visited, thirty-three, viz.:

Brockport	3	Clarkson	8
Hamlin	10	Sweden	8
Ogden	3	Fairport	1

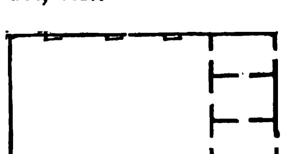
Information was obtained in one-half the cases either from the trustees or the teachers or school children and parents. In the remainder of the cases it seemed unnecessary to devote time to a tedious search in thinly settled districts for some responsible person. The type of house is not susceptible of wide variations, and in most cases a good view of the whole interior can be had without the formality of asking for a key.

Twenty-eight of the above list have but one or two rooms. One in Brockport has three; one in Spencerport, four, and one in Fairport, seven.

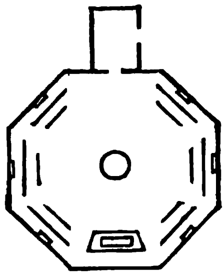
The typical country district school-house is planned very simply. It has usually a vestibule of some sort and an oblong school room with windows on two sides, frequently three. A school just built and not yet occupied shows the type perfectly.



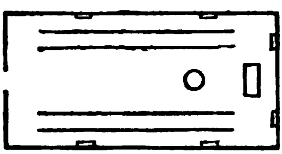
Here, the windows occupy three sides, an arrangement equally common with that on two sides, viz.:



One octagonal house was found so contrived that each scholar faces



three windows and the stove. One was found with the seats in four rows, facing opposite so that each scholar had two windows and a stove in front of him.



The light, at all events, was sufficient in these schools, however badly disposed.

In all the smaller schools the two sexes study in the same rooms, boys sitting on one side, girls on the other, but a separate entrance is often (and properly), provided with a vestibule for each sex in which their clothing can be kept apart. The water is almost invariably fetched from a neighbor s well and kept in a wooden pail. The heating is performed by stoves which never have jackets. An open scuttle often leads to the garret, and may serve as a ventilator if the roof is not tight, or more properly as a waster of heat. The rooms are often crowded; sometimes the reverse is true. The desks are generally of a very stiff and ancient pattern, the paint worn off, and the wood carved by the toil of many generations. The floors are apt to be badly worn, and if the walls are plastered (as they generally are) the plaster is pretty sure to be defaced and broken off. Nevertheless, among these little cheap buildings one was found quite new, and two or three others almost practically new and in an attractive condition.

As a specimen of what a district school *may* be, the following case is given: "An old wooden house of one room with a vestibule. It contained about forty pupils last winter. The floor has settled and a crack in the wall lets cold air in upon the feet. The privy is ten feet distant. The windows occupy three sides of the room. The house is greatly in need of a new floor, blinds and fixtures, seats, desk for teacher, plastering, stove and flue, water-pail, seats and floor for privy, and suitable vent holes for the sub-floor space."

The following details were noted:

Walls in seriously bad condition	4
Interior of house in seriously bad condition	2
A new house the best remedy	3
Sub-floor space not ventilated	6
No vestibule	4
Windows in front of scholars	4
Bad stoves	7
Seats new or nearly so	5
Privy, one single	4
Privy, one in two sections	10
Privy has fence outside to separate the sexes	6
Privy has a vault	2
Privy is broken	6

The floor-space per seat in twelve cases, taken at random, equalled 8 8-10, 9 8-10, 11, 12, 12 1-2, 14, 14 1-2, 15 1-2, 20, 24, 25, 27 square feet. These cases indicate a great deal of over-crowding and such is the impression generally obtained from a look at the interior. As, however, the district schools are not usually in session at this season, it may be proper to qualify this remark, and also to refrain from expressing an opinion as to the probable state of the air in such rooms. The usual heater is a wood stove, a simple oblong box; sometimes a coal stove is used.

The state of the privies is inexcusable. It is unnecessary and wrong to expose children to the foul air which is almost invariably found in them. It is impracticable to have them under the shelter of the school-house as a rule, but they should at least be in good repair and made tight below the seats to exclude the wind in winter. It is a mistake to build two compartments separated only by board. The partition is generally cut through; and finally, if the teachers would consider this part of the premises as under their charge, much might be done to keep them neat; but very few female teachers have the courage for the undertaking.

The distance from the house to the privies was measured in some nineteen cases taken indiscriminately. One was in contact; eight others were within ten feet; seven from ten to thirty feet, and two at fifty feet. The distance of the wells furnishing the drinking water from privies, etc., was similarly noted in nine cases as respectively, 150, 140, 50, 35, 20, 30, (distance from a muck yard which imparted its taste occasionally) 6 feet (from muck yard in two cases;) and in one case the well was *in* the muck yard.

The inquiry was put to all responsible persons who were found, whether any rule or by-law existed for the guidance of teachers in case of outbreaks of contagious or infectious disease. No person was aware of such a rule. No information could be obtained to lead us to suppose that evidence of vaccination had been required as a condition of entering or remaining in any of these schools. The two larger schools at Fairport and Spencerport were mentioned to us as worthy of separate visits.

The school-house at Fairport presents a fine appearance; has been built nine years. The plan is simple; a wide entry from front to

rear, and rooms on both sides. In two of the rooms the scholars face the windows. The air was uniformly close throughout the house, windows are closed; only twenty-five square feet of outlet (including gratings) from the rooms to the ventilating flues which draw sluggishly. There are 350 pupils. The mild temperature of the air from the furnace was noticeable. The latter is coated with masonry and enclosed in a brick air-chamber.

At Spencerport one ventilating flue discharged air from a neglected cellar into a school room. The roof is higher than chimneys so that back draught is frequent. The drinking water is from a neighbor's well twenty feet from a privy, and fifteen feet from an old vault.

BROCKPORT STATE NORMAL SCHOOL.

The State Normal School at Brockport is a large and well-known building, with an average attendance of from 550 to 675, of whom 350 are Normal and Academic pupils. The site is sufficiently elevated, being a piece of six acres, rising to a hight of twenty feet above the street level at the spot where the house stands. The building is a long and symmetrical structure. Its two extremities are wider than the rest; they were built in 1868. Some of the rooms in that part are so arranged as to be very hard to light, owing to the great width of the building. There are four halls with easy stairs, cutting the house into five sections, besides stairs at the ends; there are eight doors of exit; there are two hydrants in each story suitable for attaching hose; and the general safety in case of fire seems sufficiently provided for.

Indirect heating by steam-boxes in the cellar has just been introduced. Each dormitory receives air from this source, and has an exhaust-shaft besides (a tin pipe six inches in diameter), leading to the attic, where all unite in three large shafts which discharge upward through the roof. The boxes discharge through metal tubes, one 46 by 48 inches in size, the other two 30½ in diameter. The current through the tin tubes was very active, and the amount exhausted probably sufficient, as the dormitories contain but one or two inmates apiece. The air seemed generally good.

The house contains two pan water-closets for the use of the sick, and a very few set basins and baths. The soil pipes are properly extended above the roof, and traps are put where needed, but not ventilated; the sewer runs along by the west side of the house on the outside; the connections with the house are trapped but not ventilated; point of discharge is 1300 feet distant. The privy, used by all the inmates, is about a hundred feet in the rear of the house, and approached by a covered way, with two doors to prevent a draught from entering the house. There is no excavation; a few inches of earth are thrown upon the natural surface, and fresh earth added twice a week; all is removed monthly; the odor is not excessive. The well for drinking-water is forty feet distant from one end of this privy, not on a lower level. The water used for washing comes from a very large cistern, filled from the roof, situated at a great distance; it is pumped to tanks, holding ten and eighty barrels respectively, in the attic.

It was recommended that the soil under the privy should be made impervious to moisture, or cemented or a dry-earth system, with barrel-tubs. Also, that hose should be supplied; that some rooms should re-

ceive inside blinds (for there are no blinds on any part of the house); that changes be made to secure proper lighting in certain rooms; that certain stairs be altered from circle to straight, with right angled turns; that a gymnasium room be fitted up; that the existing steam coils in certain parts of the house should be boxed and connected with the outer air. These suggestions were communicated to the trustees of the school.

Public Schools in Utica.

The site of Utica is on the ancient bottom of the Mohawk river. The soil is generally sandy and easily drained. The cellars of the school buildings do not suffer from dampness, drainage being applied as required. The site of Catherine street school is undesirable, being low and in the neighborhood of canals; there are three privies within fifty feet of the neighbors' well, used by the school.

The lots are usually small, but in good order. One of the schools is in an old church, and one in a two-story hall, designed by the founder as a free public lecture-room; in both cases the yard-room is exceedingly small.

The buildings are generally planned so that each story has one large study-room sufficient to seat all the inmates of that story, with annexed recitation rooms. A difficulty in lighting these large rooms sometimes occurs. In the newest house (James St.) the room is seventy feet across between the windows, and some deficiency in light may be expected, in spite of the very liberal allowance of glass. In Francis street school a room 30 feet square is badly lighted, having only two windows of medium size The older plans are simple and possess no special merits; they usually have narrow corridors and defective accommodation for clothes, and lack the protection of vestibules and storm-doors. Remodeling has not been much practiced; but in the James street schoolhouse a great improvement has been made in commodiousness, pleasantness and space.

Good care is taken of the houses, and the privies are remarkably neat.* As a rule, the latter have vaults which are flushed by the discharge from the roof, and empty at all times into the sewers; some of this class are remarkably free from odor. A good fence runs from the houses back between the privies. In all cases, when there are two entrances to the school-house, one is reserved for each sex. Separate clothes-rooms are assigned.

The condition of the cellars was neat and good, and the air pure, as a rule. The neatest cellar appeared to be that in Lansing street. All have earthen floors. Some cellar floor-drains empty into sewers, and some into privy vaults; they are said to be trapped, but the trapping is not ventilated, and as there is no "disconnection," a possible danger is to be foreseen there.

The chief point to which exception must be taken is the ventilation. The flues are small, built of brick in the outer walls, and open into the garrets; their action was very generally feeble, and their size altogether inadequate. Triangular tin ventilators have been placed in corners of rooms in some cases; the idea is a good one. The regulations, with the object of preventing colds, very properly forbid that scholars shall sit

* Washington street school forms an exception; some are unprovided with urinals.

in draughts; but it seemed in some cases as if the fear of the outer air were carried too far. In one school, however, the teachers expressed pleasure at their opportunity for airing out the building, which the intermission afforded; they staid over; ate lunch, and kept the windows open until the school reassembled. In a great many of the small rooms it would be dangerous to open windows; and the ventilating flues from this class of rooms were of the least possible value. The weather was very mild at the time of the visits (at the end of October); a high temperature in the rooms, say from sixty-nine to eighty-two degrees, was often noticed; and a lower range, judging by sensation, was infrequent. Some window-boards have been placed under the sashes; a more systematic use of them is desirable, as the most immediate means of relief. The Academy with its ample room and liberal entries, is the best ventilated building.

The recitation-rooms are the most crowded parts. In Francis street school there is one of fifteen by twelve feet in size, with an average constant attendance of thirty scholars (often thirty-five or forty), giving seventy cubic feet of space to each. This room has but one door and one window, neither of which can be open in recitation. In Aiken street school twenty-five pupils sit in a room which allows ninety-six cubic feet to each, with a stove burning, and a temperature of eighty-two degrees at the teacher's desk. In Miller street school there is one room with nearly forty scholars, and an allowance of a little over one hundred cubic feet each; in another room with one window, thirty-five scholars, with seventy-two and one-half cubic feet each. In Lansing street school, a room eleven feet and two inches by seventeen feet and six inches, and thirteen feet high, sometimes contains a class of A B C pupils, fifty in number, which allows fifty-one cubic feet of air to each! In South street school, one room, twenty three by eighteen and one-half feet, and only eight feet high, is divided in two by a board partition, and classes recite simultaneously in both, with closed doors (as is usual in such rooms). The average number in each of these classes being twenty, the space per head is eighty-five cubic feet. In Hamilton street school, one recitation room in constant use allows seventy-five cubic feet to each one of a class of thirty-three (average). These are not very exceptional cases. The houses in most instances have sittings for a larger number than the actual attendance.

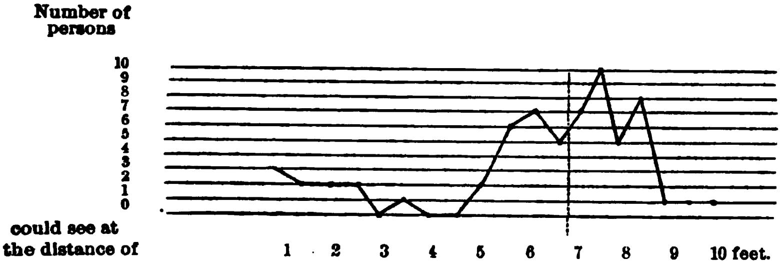
The administration of the schools is worthy of imitation in several points. The regulations in respect to contagious diseases are strictly observed; a part of the credit for this is due to the city Board of Health. Vaccination is enforced, and teachers are required to attend to the enforcement by inspecting the children's arms. The direct personal influence of the superintendent (Prof. McMillan), is seen in the cheerful tone of the schools, in the neatness of the premises, and in the excellence of the singing and light gymnastics. There is a regulation forbidding detention at noon or recess.

In the Utica Free Academy an attempt was made to ascertain approximately the number of near-sighted pupils. The test was applied as follows:

A narrow recitation-room, well lighted from one end, was selected; the black-board occupied one of the long sides, on it was marked a scale of feet and inches, the pupils were called in one at a time, and placed at a certain point close to the board, with their backs to the

window; at another marked point on the board the observer held a page of print, detached from R. Brudenell Carter's "eyesight, good and bad," which the author states, should be easily legible to the normal eye at the distance of seven feet, which was the distance in the present experiment. The page stood exposed to the light of the single window, nearly at right angles to the incident rays. The observer was able to read it at ten feet, he was instructed to cease experimenting when the light was insufficient for that.

Sixty-three young ladies were thus examined. The total number of Academy pupils was a hundred and twenty. Thirty-three could read the letters easily at seven feet and over; thirty had to go nearer; of the latter, eleven could not read easily at four feet, viz.: *three* read at one foot; *two*, between one and two feet; *two*, at two feet; *two*, between two and three feet; *one*, between three and four feet. The letters used were of the size following:



This diagram gives a view of the proportion of those who could see distinctly at the distances of the ten feet, and at distances between. Those of less than normal visual power are at the left of the dotted line.

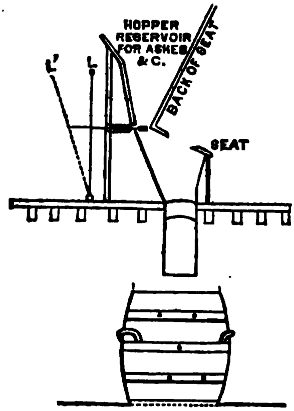
No scientific value is attached to the experiment, but it may have its use in showing a larger amount of near-sightedness than was suspected.

Earth-Closets and Dry-Removal or Tub-System.

[Example at the Orphan Asylum, Utica.]

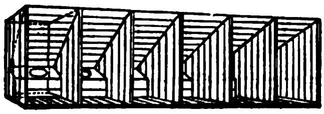
The closets here described have been in use two years. They work most satisfactorily and are in as good condition as when first used, and as free from odor as after having been used for a month.

EARTH CLOSETS AND THE TUB-SYSTEM.



E 18. Reservoir and hoppers for ashes and disinfectants behind the backs of seats.

L is a *lever*, which, when pushed or pulled back to L', opens a *valve* and discharges ashes, etc. The valve can be made to work automatically by special arrangement to secure action by the *seat*.



FRONT VIEW OF SIX CLOSETS.

The closets were constructed for children, and some arrangements are necessary that would not be required if built for adults. There are now about 130 children in the institution, aside from attendants, etc., all of whom use the closets. These closets are supplied with the anthracite coal ashes. The hoppers will hold several days' supply and are replenished by the janitor at such times as he finds necessary. There is an ash-room in which to store ashes. The levers or pulls, to shut the valves, are placed in the hopper reservoir, out of reach of the children, who otherwise would tamper with them. The levers are hinged at the floor, and arranged with a coil-spring to close them. Each seat or opening is connected with a galvanized iron tube extending to the cellar, through which the excreta fall. The lever when pulled opens a valve about four inches in diameter for discharging ashes into the delivery tube, and this into the tubes below, where the ashes fall and cover. Under each tube stands the movable tub.

Twice a day the janitor pulls each lever and lets a stream of ashes run. The tubs are filled in the course of a few weeks, and when filled and covered with ashes, and without charge, farmers take them away and return them empty and clean. No odor or nuisance is produced even in the cellar where the tubs stand.

Schools in the city of Rome.

There are eight within the city's jurisdiction; all brick except two, which are of wood. Seven have two stories, and one has one. They are placed on lots usually of sufficient size, free from nuisances or encumbrances.

The soil is naturally of a character which renders special paving unnecessary, being a loamy gravel, very pervious to water. No school building has any drain or sewer, and all are free from dampness.

No house at present has a place to wash hands.

The water for drinking is obtained form wells usually sunk in the cellars. They penetrate a layer of considerable but varying depth of cobble-stone and gravel, and usually pass through blue clay below it before striking water, going to the depth of about twenty-five feet.

The water from five of the school wells has recently been analyzed by Professor Elwyn Waller, of the Columbia School of Mines; one has been found impure and the rest pure.

The school privies are situated at the following distances from the water supplies: Liberty street, 90 feet; Academy, 75; Jay, 60 or 70 feet; Thomas (25 feet deep), 45 feet. The privies are all of wood over simple vaults of masonry. The present superintendent says they have not been cleaned for a year, at all events. They have to be excavated in the usual old-fashioned way. Free use is made of disinfectants (copperas and lime), and the vaults at the time of my visit were not very offensive. They are objectionable, however, in other respects, being usually well soaked in urine. The urinals are troughs, without bottoms, discharging directly into the vaults. They are mostly of wood, saturated and offensive. A weekly cleaning of the wood work is directed, and doubtless carried out. There are in five cases two separate houses with a fence between; in three cases but one house with fence.

Distance from school-houses (in order), 45, 50, 10, 38, 12, 70, 30, 25 feet.

The school authorities have, within a very short time, caused the vaccination of the school children under the authority given by statute to exclude those not vaccinated. The teachers are made the judges of the need of vaccination; they decide by inspecting the scholars' arms. At the time of the visit the attendance was considerably diminished by the absence of those kept at home for the purpose. Contagious diseases are excluded by the teachers' authority in any case.

Among the school regulations are the following:

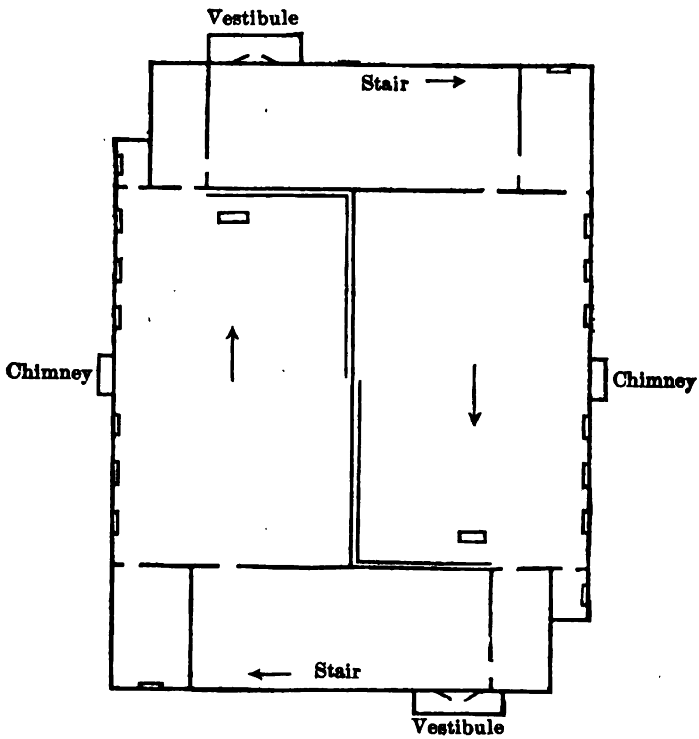
Pupils not allowed to play in streets in school-recess. Thermometer to be kept 65°-72°. Windows not to be opened in school hours in cold season when ventilation can possibly be secured in any other manner. In no case may a child sit in a draft of air. Detention forbidden at noon recess. At any other recess the child, if detained, is allowed to go out for not exceeding ten minutes immediately after.

They sing daily; no gymnastics. Cabinet organs are placed in every school. Only one house is arranged for exercises in a common hall — (the Academy).

The rooms are usually heated by jacketed stoves. Two houses have cellar hot-air furnaces. Ventilation is effected by the windows almost entirely. The air of the rooms is to be changed at recess. Most rooms have transoms. A flue, drawing well, was found in Jay street in connection with the house chimney.

Much fault is found with the Academy building, an old structure very poorly lighted up stairs, and requiring frequent descents of stairs to and from recitations.

There is one wooden house formerly used as a dwelling, and decidedly liable to be crowded and dark. There is one recent building of wood, quite good. The rest are, in many respects, fairly good buildings, and one (the Jay street) deserves much praise. The recitation-rooms are often too small, and occasionally close.



JAY STREET SCHOOL, ROME.

Ground floor showing two class-rooms 21x32 feet each with 6 windows and ventilated by chimney; five closets; separate entrances for sexes. *Light from left side only.*

PUBLIC SCHOOLS IN ALBANY.

The city of Albany has twenty-six public school buildings, of which ten were visited, including specimens from the best, the worst, and those of moderate excellence.

The newest schools are decidedly the best, and constitute proof of an enlightened effort for improvement. In this class are included the High School, and Nos. 8, 13, and 21. In neither house can there be seen any radical departure from prevailing modes of building, and there are faults

to be found; but they are very fair specimens of the best types found during the course of the visitation through the State.

Vaccination was performed thoroughly last year, but very little attention is paid to the requirement in the regulations just at present.

The High School is a handsome building, near the top of Capitol hill, fronting the parks. It was dedicated in 1876. The site allows very little yard room; the girls therefore, stay in at recess. There is a good room in the basement (48x29 feet) where the girls are practiced in light gymnastics at recess; one class of fifty comes each day, taking turns, so that each girl gets fifteen minutes practice once in four days. The boys play at will in the park (which is to be fenced, and play forbidden), or in a large basement room. There is a handsome and lofty hall in the third story, 80x58 feet on floor. The interior finish of the house is in hard wood. A corridor, fourteen feet wide, cuts the house in two; a flight of stairs is at each end of this corridor; and in the second story a branch corridor, 20 feet wide and 52 in length, leads from the middle of the first corridor to the front of the house and a third flight of stairs. The effect of this is excellent from an esthetic, and doubtless also from a sanitary point of view. The first two stories are $14\frac{1}{2}$ feet high.

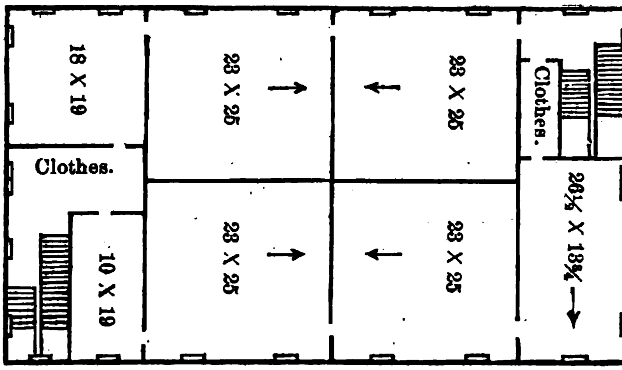
The house is heated by steam coils in the rooms. A slot in the house wall opens just behind each steam coil; but all these slots have been stopped up by birds' nests; they are hardly more than an inch wide in their narrowest part. On the day of visit the air outside was warm (47°–50°) and bright, with little wind; the rooms were warm, the average temperature of seven being $73\frac{1}{2}$° F. Some were close; on the whole, ventilation was tolerable, not excellent. The flues were drawing very unequally. All the registers were tested; two rooms were found without flues; five flues were not drawing at all; eight drawing very weakly; five moderately; five fairly well. A rough estimate gave a probable exhaust of 3000 cubic feet per minute, for 600 pupils, or five for each per minute. The windows were open a little at the tops in most rooms. The floor space for scholar in the large study-rooms is nearly fifteen square feet; and about 215 cubic feet of space. The recitation-rooms have a nearly proportionate capacity.

The deficiency in light is marked in certain rooms. In the largest size of study-rooms the amount of glass was $\frac{1}{8.7}$ of the floor-space; in the next size, $\frac{1}{9.4}$; in the smallest size, about $\frac{1}{12}$. The width of the room is too great (30 or 32 feet).

The water closets are in the cellars. The urinal was rather offensive. The pattern of the water-closet is the usual hopper which frequently gets choked; there is too much woodwork about them; too little light.

School No. Fourteen is a three-story brick building, of which the second story is here given in plan. The light is obviously deficient in four of the rooms on this plan, the window space equalling only one-thirteenth of the floor-space. There are fifty-six desks in each of these rooms, with a floor-space of 10.3 feet to each. The narrow corner room has fifty-four desks, all filled, with an average cubic space of eighty-seven feet to each. The house contains 928 sittings, and has an average attendance of 880 of all grades below the High School. The ventilation is by flues opening into the attic, and is quite defective. Vaccination has not been required this year. There are only twelve seats in the boys' privy; they are unsuitable in size, and badly fouled. Clothes are hung in two passages containing 160 hooks in three rows

(on the second story). This is the provision made for a seating capacity of 318.



School No. Fifteen is a three-story brick house with six rooms on a floor; a hall eleven feet six inches wide, with deep bays at the room doors, runs through the center. The average attendance is 825; average floor-space for each sitting in the house, 10.5, equally divided. The house is heated by direct radiation from steam-coils. The lighting is sufficient in most of the rooms. The ventilation is not quite satisfactory, and the house is, perhaps, built upon too extensive a plan, with too many rooms upon a floor.

Second District.—The house has three stories, all alike; with corridor in front, then a room 47x24, and at the rear of the latter a recitation-room, 14x21 1-2. The recitation-rooms are used constantly; the cubic space per head varies from 56 to 59, 74, 95. It was very dark and close in the larger rooms. A house stands within one foot of one side, shutting off the light completely. On the other side the nearest window to the front of the room is sixteen feet back. When the wind is from the south, one furnace fails to heat the room above it. The privies were not offensive; water is frequently thrown in from hydrants, which are sometimes let run all night. The house was built in 1832, and hopes are entertained that it will be superseded by a fitter structure.

School-House No. Seven was built in 1838. It stands at the foot of Capitol hill, on the north side, where the slope is so steep that flights of steps are used to ascend it. The light is also cut off on the west by a house, ten feet distant; on the east by a school-house built four years ago (No. 19.), distant thirteen feet; and on the northern light is prevented from entering the rooms by the fact that the corridors occupy that side. Gas is used frequently; in the lower story it is required in winter during half the time. The sky can hardly be seen from the lowest class-rooms. The first-floor recitation-room contains a furnace, designed to heat also the two rooms above it. The number usually present in this room is thirty-eight, with a cubic space of sixty feet each. The temperature of the room at the time of the visit was 78° F. Here was seen the grotesque spectacle of a room full of boys kneeling on the floor and ciphering with their slates on the settees—an arrangement based on common-sense, and showing an adaption to diffi-

cult circumstances. Other rooms are not warm enough in severe weather. No means of ventilating exist but windows. The new school-house does not at present very seriously interfere with the lighting of the old one; for, as the plan shows, there is but one window on that side in each story. It interferes very much with any prospective improvement in lighting. Vaccination has not been practiced this year. It is usual to require it, and to examine the scholars' arms in evidence. The omission of the school recess is liked.

School No. 19, next door to No. 7, is for primary children; it has two stories and four rooms; each room eighteen by twenty-four and one-half feet with fifty-six seats. The *rear* rooms, although facing the side of the hill, have only four windows, while the front rooms have five; the lower rear room suffers for want of light.

There are two hundred and twenty-four seats, and an average attendance fluctuating above and below that number, Cubic space nearly ninety feet per head. The sun was shining brightly, the air outside was at twenty degrees Fahrenheit; windows were open in the room, and the air was not very bad. The open windows seemed to occasion colds, and coughs were frequent. The ventilating shafts are insignificant, and are so placed as to waste the heat. Whatever ventilation there is, is aided much by the open plan of the house, as may be seen. There is no cellar, and the openings to the sub-floor space make the lower room cold in the floor; the teacher complains much of it. It is said that the sewer from the privies runs under the house. In regard to vaccination, the parent's word is taken in evidence of the fact. Calisthenics are practiced for ten minutes in each session. All are content without the "yard recess."

School No. 21 has a nearly cubical shape. The basement is on a level with the street, and contains furnaces, play-rooms, and a principal's private room. Each of the three upper stories has a wide corridor running through the middle; on each side of the corridor there are two class-rooms with two very large and commodious clothes-rooms. The twelve rooms are all of the same size — twenty-five by thirty by fourteen, and being all corner rooms, each has two side and two rear windows. The average attendance is five hundred and sixty-four, which allows to each scholar an average of two hundred and twenty-three cubic feet of space in school-rooms. The house stands freely exposed, in a thinly-settled quarter. All these circumstances favor good ventilation; and the result is good. How much influence is exerted by an exit of less than half a foot of practicable aperture to each room, may be questioned; the draught, however, at these exits was very good, being sustained by the heat of smoke-pipe. The privies are situated in a row of dark, dungeon-like brick cells at the end of the yard; the seats are too high for young children; there is no door, but high screens, and inspection of the localities is very difficult. It is said that outsiders visit them. The woman janitor naturally does not do police duty. All is neglected. The place shows proof of serious lapses from the customs of civilized life.

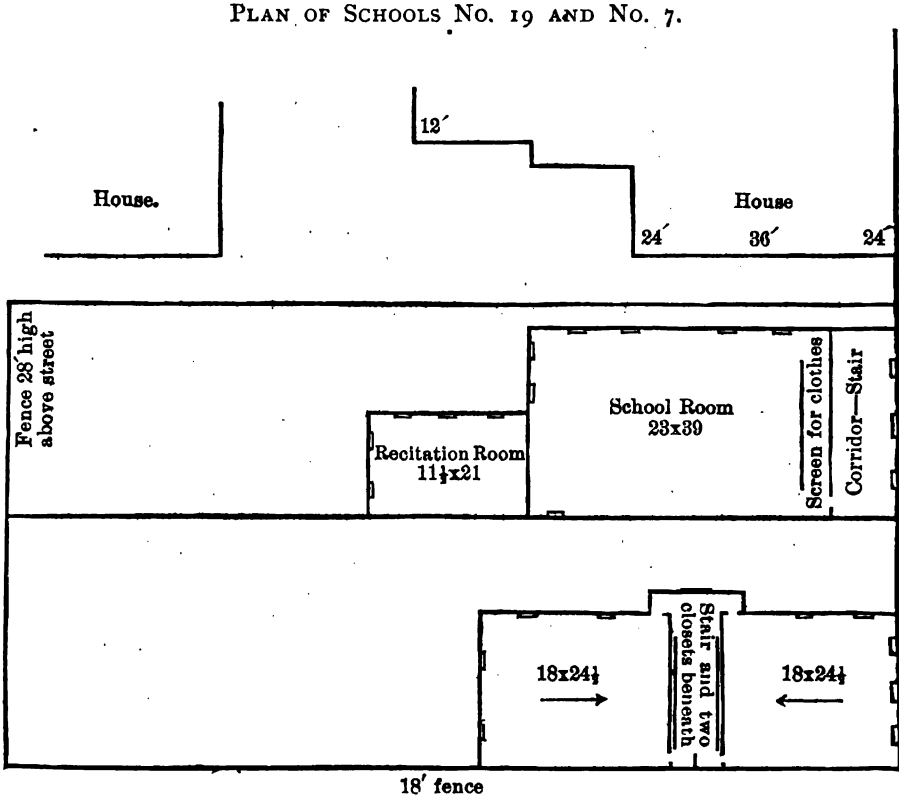
School No. 8 is just completed, and is an attractive and desirable house. It has two stories, with four rooms in each; and a corridor through the middle with front and back entrances, and doors swinging outward. The interior finish, in wood and tinted rough plaster, is noteworthy. The ventilation is secured by strong draughts through

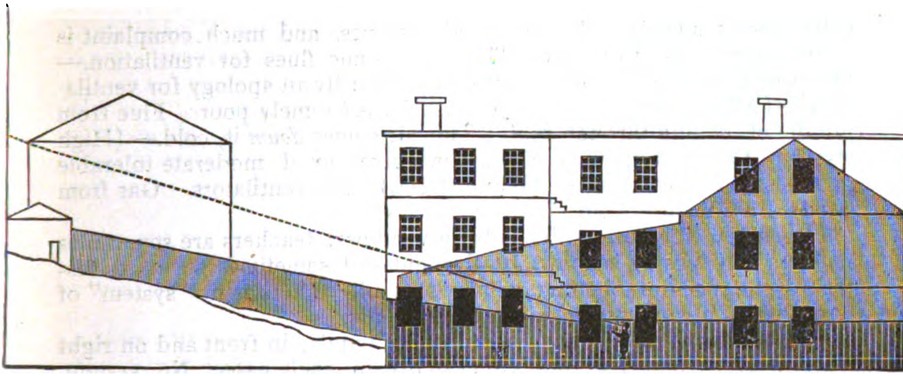
flues heated by furnace smoke-pipes. Each flue exhausts from two rooms in different stories. The water-closets are of a new pattern which works well and deserves praise for neatness.

School No. 17 is built upon a plan resembling that of No. 14. The means of ventilation are very deficient. The size of the rooms is 28′ 2″ x 20′ 4″ and 15′ high=8595 cubic feet per fifty-six pupils=153 cubic feet apiece. There is abundant light, and a relatively good supply of air from the furnace. On putting the question to the teachers and scholars of the four lower (primary) rooms, it was found that the subject of vaccination had not been mentioned during the current school year, and that twelve children were unvaccinated in a total of about 160 present.

The Albany Academy is not a public school. It was built in 1875 for the present use, upon a broad and handsome scale. The rooms are large; in fact rather too deep (thirty-four feet) for thorough lighting. There is a good play ground, but it is not much used by the boys, who prefer the Park. The older half of the school is drilled with muskets twice a week from twelve to one o'clock by Col. Pfisterer. The school-hours are from nine to two for the older boys, with twenty minutes recess; for the younger from nine to twelve or twelve and one-half. From one to three hours of study are required at home; there are twenty-five boys who average four hours a day. The school-house is neatly kept, but the air is rather close, and there are no means of artificial ventilation worth mentioning. The privy accommodations are much too small.

PLAN OF SCHOOLS NO. 19 AND NO. 7.





School No. 7, Albany, longitudinal section, from front on Canal St. to a fence 28 feet above street level, in rear. The outlines of the house beyond, distant 10 feet, and the fence distant 4 feet, are given with shading; the windows which are obstructed are given in full black. The dotted line is the direction of the visible horizon (Elk St.), which the boy is looking at.

Public Schools of Schenectady.

There are nine school buildings with about 2,000.

Soil of city, sandy. High ground in north. Slopes down to Mohawk river. On high ground are three schools; on medium ground three, and on a site bounded by the Erie canal, and 6 feet above its water are three more. Soil water moves down from bluff towards river. Town is supplied with water chiefly by wells of moderate depth and generally pretty near to privies. No proper system of sewerage exists. Only two schools are provided with city water (Mohawk river by Holly system); the rest have no drains.

Water in some wells in low parts of city is known to rise and fall with changes in the canal; this is true of the water in the well used by the large group of buildings called the Union School.

The privies have vaults, and proper separation of the sexes is made (with one slight exception). They are distant from forty to one hundred and fifty feet from the houses and from the wells from 100′ to 150′ Their condition was noted as filthy in one case. In another the boards are soaked and the whole concern offensive (without neglect on part of the janitor). The floors are old and worn, and holes are bored in them to let water run into the vaults when they are rinsed. In the house in White street and one in rear of Union School, dampness was much complained of; there were no cellars; insufficient ventilation under floors.

Heating and Ventilation.— Direct steam in Park place school (the newest school-house) which has ventilators of insufficient size, but drawing strongly. The clothes-rooms are in the cellars, which have no ventilation.— (Albany Hill.) Mere apologies for ventilation open into attic. Heated by hot-air furnaces. Children's clothes kept in same room with furnaces (cellars) and air for furnaces drawn from those rooms.— (Union School.) Partially heated by furnaces; clothes-rooms not separated from furnace rooms, and the supply of air taken from

cellar indiscrimately. There are also stoves, and much complaint is heard on account of the gas. There are some flues for ventilation.—(Rear of Union School-) Two buildings. Hardly an apology for ventilation.—(Albany Hill, annex.) Air usually extremely poor. Flue from middle of ceiling through roof. The air comes *down* it, cold.—(High street.) Constant opening of windows gives air of moderate tolerable goodness. Stoves, gassy.—(White street.) No ventilators. Gas from stoves. Very close, poor air.

In general, ventilation depends on windows; teachers are sometimes reckless in exposing scholars to draught and sometimes seem to disregard the need of opening windows at all. There is no "system" of any efficacy in comparison with requirements.

Bad lighting is frequent; light in front of pupils; in front and on right side; in front and rear only; repeatedly in each case. No system. There are some rooms in the Union School of preposterous forms which cannot possibly be well lighted, *e. g.*, a room 67x27 and window; at the two sides only twelve feet high.

Vaccination not insisted on. A strong German opposition prevails. In contagious diseases the certificate of physician is required before a child returns to school.

The experiment of omitting *recesses* (except in the lower grades) is now being tried for a month. This makes the school hours at present, 9 to 11½ A. M. and 1½ to 3½ P. M.

Public Schools in Bath-on-the-Hudson.

On a lot which should have been larger and might easily have been made so, stand an old and a new school. The site is the slope of a bluff, one-third of the way up. Six streets not thinly settled, run parallel to the river on this slope. All the houses have pit privies; there being no sewers. The soil is clayey; near the foot of the bluff stands the well which supplies the school with drinking water. The yard is muddy; the school-privy is thirty-six feet from one school and eighteen feet from the other; it is in two sections with seven seats in each; back to back with board partition; the floor is defiled; the vault consists of a series of square wooden boxes quite full, which are removed from time to time. There is no partition between the sexes in the yard; they have their recess at different times, and this again prevents thorough airing of the school at recess time.

The old house originally formed a parallelogram (31x46) but wings have been added so as to cut off half of the windows on each side and leave it quite dark in portions. Four of the stoves connect with one chimney of three flues, the central flue alone being carried through the roof. A week ago it was discovered that two of the stove flues were connected with side flues in the chimney so that the smoke entered the garret and filled the house. Water stands in the cellar in the spring; It is full of decaying old lumber. The ceiling has repeatedly dropped large pieces upon the desks. The floors are in poor condition, the desks ancient. The doors open in, and on the stairs half way down there are doors swinging inward. The air is poor.

The new house is used by primary pupils. A house twenty-four feet high stands twelve feet from one side opposite two windows; another

house opposite one window on the other side; this should have been prevented by a larger building area. One room was well ventilated; another was said to be so. Another (said to be very close) measures 15x30 feet and has an average attendance of eighty-six pupils, of the age of 6.3 years. This allows scarcely more than five square feet of floor-space per head.

Cases of contagious disease cause the exclusion of the whole family; such cases are found out in various unofficial ways. Vaccination was enforced last year, but it is not now, and probably will not be until a new epidemic occurs.

Public Schools in Cohoes.

There are eight school-houses and an average attendance of 1567 children with forty-two teachers in Cohoes, giving an average of fifty-seven pupils to each teacher.

The experiment of omitting the fifteen minutes recess in each session has been tried for a year with apparent success. The hours of school have been reduced from 9–12 A. M. and 1–4 P. M. to 9–11½, and 1–3. The teachers of primary classes have the option of dismissing at 11 and 2:30, but do not all exercise it. Gymnastics are practiced to some extent by primary classes. It is thought that by omitting recesses a great deal of evil communication, obscenity and profanity is prevented and that the scholars get along very well without the intermission. The children used to come in dirty and excited and ten minutes were lost before they were fully able to work again. The suspension of work for five minutes at the close of each hour, with physical exercise and opening of windows, is recommended, but is not carried out by all primary teachers. The programme of the day's work of one primary class is here given:

Hour.	
9–9:30	Addition by all.
9:30–10	Subtraction. / Study of lessons. } Alternate days.
10–10:30	Arithmetical tables.
10:30–11	Music, fifteen minutes; study spelling, fifteen minutes.
11–11:30	Table class.
1–1:30	Spellıng (by all.)
1:30–2	Arithmetic tables by those who have not recited at ten.
2–2:30	Write one day; draw the next fifteen minutes and study of reading lesson for fifteen minutes.
2:30–3	Reading lessons.

Members of a family where contagious disease exists are excluded. There is no enforced reporting of cases to the Board of Health or school board. The regulations order all unvaccinated children in attendance to be vaccinated, and it is required that no scholars shall be admitted without presenting to the teachers a medical certificate or other evidences. The rule was enforced last winter by the health officer, who personally visited the schools and performed vaccination in all needed cases. An epidemic of small-pox was then raging. A similar enforcement was made during a previons epidemic, seven years ago. In the intervals no effort is made and no record kept on the school books. The results are, that scarcely any above the primary grade are unpro-

tected; but as regards those in the primary grade the protection will be less certain.

The duties of superintendent are devolved by the regulations upon the principal of the high school. This gentlemen has already fully enough to do in hearing seven recitations a day.

As a general thing ventilation depends almost entirely upon windows. The preferred plan of building seems to be that of four rooms on a floor divided by one corridor. The newest houses are the best and most attractive, with the exception of West Harmony school. The crowding of schools is not a very marked characteristic. As will be seen, there is much neglect to janitor's work, *and inattention to details of repairs.*

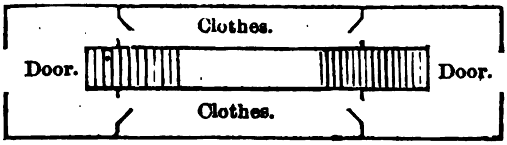
The High School was formerly a dwelling-house; it has three stories and a basement. In the basement one room is used for primary scholars, average attendance sixty-two, floor-space eleven feet each; cubic space per scholar ninety-nine feet. The light is poor — two small windows in front of the scholars and two behind equalling one-thirteenth of floor-space. The room is three feet below the ground. The first story contains one room with forty-three children of ten years of age in attendance, and a floor-space of ten feet each; one hundred and twenty cubic feet each; light insufficient. Another small room contains sixteen pupils of the age of sixteen; it is much complained of for closeness, and has no inlet or outlet for air. In the third story there is one large room for the high school, with an allowance of twenty-four square feet of floor-space apiece. The house has two stair-cases and a fire-escape. There is one hot-air furnace — but not equal to demand. There is a sufficiency of wardrobe space. The water-closets are placed in a three story L. Those in the second and third stories are used by girls exclusively, which seems a very proper arrangement. The one in the first story is foul and wet; one closet gives no stream, while another throws water upon the floor. The number of seats (8) is too small for an actual attendance of over two hundred. The pattern of hopper used is poor, and the supply of water, at times, insufficient.

The White Street School has two stories. In two large rooms the pupils face a bright light. The floor-space in three rooms (primary) was noted as eleven, eleven and sixteen square feet per head. The clothes are kept in neat enclosures in the corridors, eight feet by four feet; the wall or fence being only eight feet high. There are two flights of stairs. The outer doors open outwards. The house is heated by direct radiation from steam coils. There are eight ventilating registers in each story which do not draw, they seem to go to the attic which has at the top one round ventilator. The water from the yard occasionally runs into the cellar; the latter contains a drinking faucet, and also five hoppers (very poor articles), and one broken pan-closet. The school board is about to introduce much better arrangements. The boys' privy, only twelve feet removed, is in a bad condition. The floor is broken through. It contains only six seats. The number of sittings is 342, and attendance somewhat less.

Columbia Street School was seen after hours. It has two stories with four rooms on each (28x30 feet). In five rooms the seats faced a strong light. It should be remarked that teachers "generally keep the shutters closed" when in front of the pupils, not always however. A very

rickety pattern of desk and seat was noticed in one room with its woodwork fastened to the iron by light screws.

The clothes-closets are peculiarly arranged. The corridor runs through the middle of the house with a stair facing each entrance door. The midspace is thus occupied by two flights of stairs and the passages on each side are converted into closets by simple partitions, thus:



This saves space but interferes with free diffusion of air. The house is heated by steam coils in the rooms. In two rooms there were found no ventilator-openings, in three the valves could not be opened; in one other there was a slight current. The cellar was full of rubbish and the sweepings of the rooms. The two privies touch the house at different corners. That for the girls has six seats and is neat, a hydrant runs constantly in the yard and the water flows through the vault. The other privy has no urinal; the seats are too high and strangely inconvenient. The floor is covered with ordure and has great holes broken through. The door is stuck half-way. The vaults are cleaned once a year.

East Harmony School contains three rooms in a basement and two upper stories. The basement room is deficient in light. It contains a portable furnace for warming the two upper stories; the air supply is drawn directly from the room over it by a pipe. The windows in the house were generally well open. Some obsolete registers admit currents of cold air upon the scholars, and are therefore disused as ventilators. The water supply is taken from a hydrant. The house is of recent construction and is pleasant and neat. The children are taken from the poorest part of the population.

West Harmony School is a three-story brick house not fully occupied, on a magnificent site. The first thing noticed on entering was the darkness of the corridors and stairs, which receive no light except what comes through small transoms in the doors of class-rooms. There is but one stairway, of a single run, five feet wide for each story; this may be considered unsafe, under the circumstances. A musty smell was perceived in the corridor at once. The door was open to the cellar; on descending the latter was discovered to be almost wholly underground and totally dark, except in one small corner. With the aid of a lantern and a strange odor as a guide, the soil pipe was at last reached and was found to be leaking upon the earthen floor. The leak had been partially stopped with canvas and paint — if that were not the original joint. The house contains six rooms used for hanging children's clothes; each of these rooms contains three hopper closets of poor pattern, and two contain urinals. There is no separation by door between the clothes and the water-closets. Garments were hung thickly and strewn on the floor. Each room opened *directly* into a full class-room, the teachers of which made bitter complaint of the nuisance. One of these closets was found very offensive, reminding one of the smell of a filthy lunatic's cell. The others were neat, but the hoppers were mostly broken or out of

order. The boys go to a building that touches the house. It has two doors, one locked, the other evincing long neglected defilement; only two seats; the asphalt pavement outside is preferred by the boys. The yard fence is broken. The washing of the school floors is said to be neglected. The house is heated by direct radiation from steam coils. In most of the rooms windows were wide open; the temperature of the house averaged 71° and that outside 40°. The ventilators are not to be relied on. The roof is leaky, and air currents enter the third-story rooms freely. The floor-space per head of actual attendance was 11 1-2, 11 1-2, 12 and 15 (primary), 11 1-2, 16, 12 and 24 (higher grades).

Pleasure Ground School is considered the best in Cohoes. It has two floors, each with two rooms and a good entry and stair between. Ventilation depends on windows. There are in each room two orifices of eight inches in diameter. Stoves are used. In one room there are seventy-eight little children from five to seven years old (floor-space nine feet each), "and ninety-six belong." Size of rooms, 30x23. The girls' privy is thirty feet from the house; the boys' is 120 feet distant, has *sixteen* seats and is perfectly neat, but the trough was very carelessly fastened and is broken down.

Lincoln Avenue School is a two-story wooden house, neat, pretty, and convenient. One room in each story (23x22); lot 132x120; stove heating.

Slate-yard School comprises one room in a wooden house, poorly lighted but not crowded.

Public Schools in Waterford.

Union School No. 2.—This school building stands on muddy and loamy ground, encircled by the Hudson and Mohawk rivers and a canal. The river sometimes overflows the ground it stands on. At the time of the visit the teacher said that some of the pupils were absent on account of malarial fever. The house requires little further mention, having but one room, not crowded. Scavengering of the privy had not been neglected.

School No. 3.—This has two rooms; in one the cubic space is ninety feet per scholar, in the other, 210. The temperature was at 84° F., estimated, but no thermometer was found in the schools. Sewer runs through school-yard—empties in canal.

The Academy.—This is an old three-story house, poorly fitted for the purpose it serves. The ceilings are nine and one-half and ten and one-half feet high; the windows insufficient, and some rooms very poorly lighted; the rooms generally rather crowded and small—*e. g.*, a class-room of 18x33x9 1-2, and fifty-five pupils in attendance, giving 100 cubic feet of space to each, and others similarly situated. The ventilation, it need not be said, is very imperfect. The cellar is dark and unaired. The privies are much too small.

Vaccination was practiced in the town last year, with the effect of checking an epidemic of small-pox in the beginning; it is not systematically enforced in the schools. Much contagious disease is believed to be concealed. The presence of measles in a household excludes those who are sick, but not other members of the household.

Public Schools of Troy.

In this city of 60,000 inhabitants there are sixteen public school-buildings with 8,738 registered pupils, and an average attendance, for ten months previous to July, 1880, of 5,613. This disparity is due

to the large inducements to profitable labor at light employment, which are offered in Troy and in some of the neighboring places as well. It is estimated that there are over 13,000 persons from five to sixteen years of age in the city.

The schools are greatly overcrowded, and in numerous cases the lighting of the school-rooms is excessively bad. The ventilation is generally poor, as might be expected. In a considerable number of instances the superintendent, Mr. David Beattie, has procured the insertion of new flues made of tin, one foot in transverse section, which are carried from the level of the floors directly through the roofs, and capped to prevent rain from entering. These flues are encased to shield them from cold air opposite entries where it is necessary to pass them; they are not exposed to the outer atmosphere and they were found to draw quite well in every instance where these conditions were strictly fulfilled. They are opened only at the base. Artificial heat, by gas or oil, and an increased number of flues, is required for perfect success. Windows are generally found open in moderately cold weather.

The houses are generally planned with large study-rooms, and small recitation-rooms attached. In five houses glazed partitions are used.

An epidemic of small-pox broke out in Troy, in August, 1880, and lasted until June 10, 1881. Of 806 cases 248 died. The Board of Health ordered the exclusion from the schools of all who could not show a physician's certificate of vaccination, or of immunity from small-pox. This order was enforced, but there were numerous instances of refusal and consequent exclusion from school. The teachers are frequently reminded of the existence of the regulation; they do not possess the discretionary power; nor do they examine the children. If contagious disease appears in any member of a family, all are excluded from school until a physician certifies that they may safely attend. Information is obtained in any available way.

The schools are mostly well placed. The lots are in some cases so small that the erection of neighboring houses cuts off most of the light. In three cases (1st, 9th and 10th wards), the cellars are damp, occasionally or constantly, from inflow of spring and surface water. In one school two lady teachers were seen in the yard at recess time, actively engaged in police duty among a boisterous and mischievous group of boys. This part of school-duty is certainly useful if not agreeable, and is probably well performed in Troy.

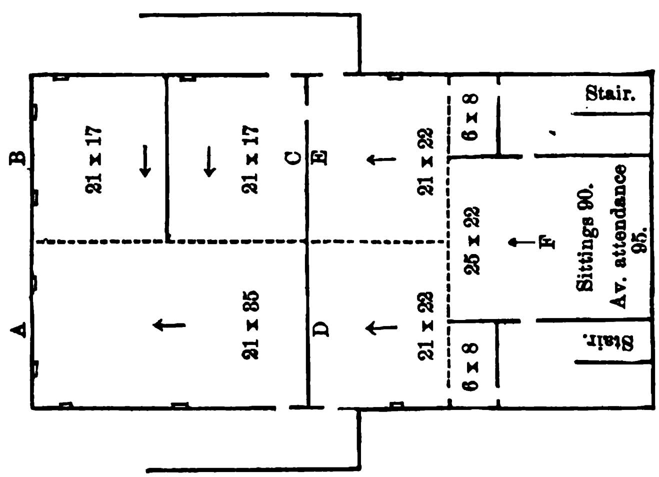
First Ward School No. 1 is a two-story brick house, the first story of which is properly used for class purposes. In the second story there are two recitation rooms, 14 1-2 feet square, one of which has regularly from 45 to 60 pupils in attendance; when the latter number are present the cubic space equals 43 2-3 cubic feet per head. The ventilator flues are very small, and open to the attic. The air is very close in the large room, which seats 120 and averages 130 in attendance. There is no urinal. This school is located in a region of the lower class of population. It appears very well managed.

No. 2 is in the best part of the city. It is a building with pretensions to elegance, but is placed on a very small lot, and on low ground. The attendance averages 456; the sittings number 668. The house is 72x75 feet, three stories high. The ventilation seemed very fairly good in the

large rooms (whence usually a portion is absent reciting). This stands related to two factors. First, the amount of space (nineteen square feet of floor-space per head for average of all the rooms); and, second, a good current into brick shafts, one on each side, 4 feet square internally, containing a steam coil. If the seats were all full it is safe to say that the atmosphere would be less pure. The partitions are of glass and very poorly made. The clothes-rooms are very small. The boys' water-closets in the cellar are well lighted but are badly worn; the smell is peculiarly unpleasant.

Second Ward School. Floor-space per pupil on first floor rooms 13, 9, 5.7, 11.5, 5.5 square feet each. The second floor is similarly crowded (8 and 9 feet). The light is very bad. In A two of four available windows are in front. In C, D and E there is one window each. Blinds have to be closed in C and E when the sun shines. Ratio of glass to floor-space in A = 2-17 inches; C = 1-17 inches; D and E = 1-22 inches apiece.

The following diagram will give an idea of the school.



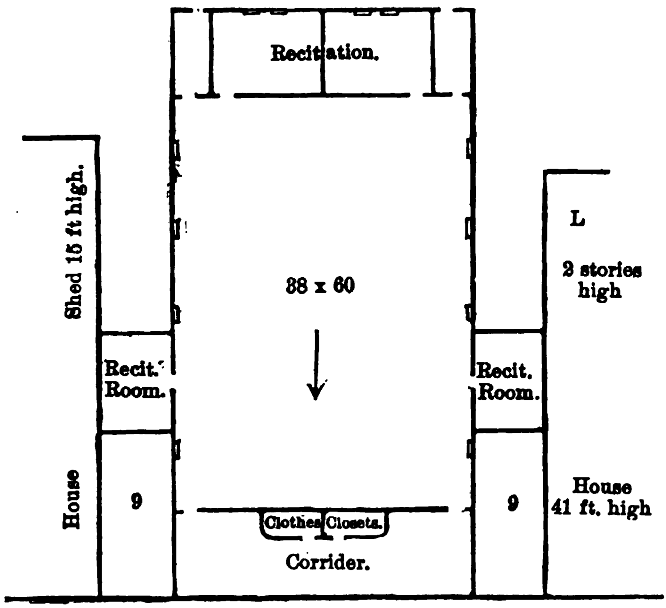
SECOND WARD SCHOOL, TROY (first floor).

The air for supply of furnaces is taken in part from cellar and front entry. Ventilation is not steady and chiefly into garret. A spring of water runs under the house and rots a portion of the partition in entry. The privy is 25 feet distant and overflows into a street sewer. Clothes-rooms deficient. Floors and windows not washed for ten weeks.

Third Ward School. The first floor recitation-rooms average a floor-space of 4 4-5 sq. feet per pupil. One recitation-room on third floor often has 30 pupils of adult size (High school) for thirty-five minutes at a time, giving less than four square feet of floor-space to each. The light is extremely poor in the rooms on the first floor especially. For three weeks during last December the scholars wrote but once for want of light. On this floor the sittings are 216; average attendance 240-260.

The wardrobes on the first floor are two in number, each 8x4 1-2 feet. without light, and kept locked. The cellar is not neat. Waste from trapped basins one on each floor goes to privy vaults, which overflows into a sewer.

Below is the plan of the first floor showing obstructions to light.



Fourth Ward Grammar School. The first story is eleven feet high; floor-space per head equals from four to six square feet. The second story has, in recitation-rooms 60, 108, 108 cubic feet of space per head, and the principal *thinks* that ten per cent of those that have been there three years have defective vision. The closets are very small and dark. The floors and stairs are old, poor, and badly worn; the stairs are too narrow and dark, having no window. The windows are practically the only means of ventilation, and the air was far from good. The light is very poor in many parts of the large room. The defective points are as follows: (1) The scholars face three windows. (2) The rear end extends eighteen feet back beyond the side windows. (3) There is a two-story house, painted brown, on one side eight feet distant and covering all the windows on that side, and (4) the windows are small and ceilings but 11 feet high. The drinking places (trapped) and the privy drain to a sewer.

Fifth Ward School, No. 1. The house is greatly overcrowded. Several children were seen sprawling on the platform in both stories. In the first story the attendance was 165 (average) and the number of sittings 140. In the second the attendance was 130, number of sittings 108. One recitation-room had three and one-half square feet floor-space per head; two others had under six feet. The house is aged and the wood-work is cut and worn. There is no cellar only a sub-floor space. The privies are poor and nasty, and urine stands on the floor; they occupy the highest part of the lot, which slopes steeply to the house at the lower end; a contamination of soil probably occurs. In

fine, the children's faces were dirty; this was but in harmony with the surroundings.

Fifth Ward School, No. 3, is an old wooden house formerly used for liquor selling and prostitution. There is but one room twenty-one by twenty-nine in each story. Pupils number 150–160. Their behavior and attainments are said to be excellent; their parentage good. The rooms are exceedingly inconvenient as well as crowded. It is almost impossible to get good ventilation. In the rear on rising ground is a poultry-yard adjoining the house; also a privy, a little farther up, without a door, minus half the roof, and facing the street at a very short distance; there is but one for both sexes; one vault after another has been dug, used and filled in without being cleaned.

The Sixth Ward School-house is four years old and is well built except as to the floors in two of the three stories. There are good stairs, two good wardrobes on each floor, and a high and dry cellar. The site is on the verge of a high, steep bluff. The house is less crowded than some others; one recitation room however (15′ 6″ x 22′ 8″) has seventy or eighty children, or four and one-half feet floor-space to each. The two privies are only twenty feet distant, smelling badly, and not properly emptied and repaired. The inlet of air to the furnace is just opposite.

The Seventh Ward School is an old brick house of two stories. The first story is a solid block of four rooms, parted by glass sashes. It is entered directly without a vestibule from front to rear. To get to the second story it is necessary to pass out of doors. There is one stairway at each front corner; the stairs are three feet wide, have one sharp turn, and are lighted almost wholly from the door (if that happens to be open). The clothes and umbrellas are kept in the rooms. Of eight side windows, two on one side and one on the other, are almost wholly deprived of light by neighboring houses. In the second story, the large room (forty-eight by thirty-one) has only three available side windows (one-thirty-seventh of floor-space) and three in front of scholars; in fact the lighting is of the worst. There are no corridors or vestibules. The first floor contains about 1,800 square feet, average attendance 230, sittings, 220, floor-space per head equals eight square feet, Second floor, attendance 150; floor-space per head, twelve square feet, but with much closer crowding in recitation-rooms (five and three-fifths, four and four-fifths, four and one-half square feet to each child). Excessive stove-heat. Ventilation by windows; flues feeble. The privies are very dark; that for girls has no light when the doors are shut, and an eight foot screen is close in front. The yard drains into the vault and the latter into a sewer. The cellar is very dark.

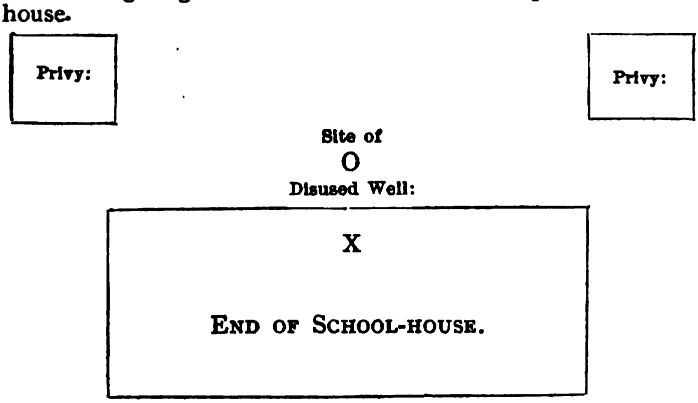
The Ninth Ward School is in a malarial district and was closed two or three months last year on account of small-pox. There was no mortality to speak of among the school children. It is a crowded house; 348 sittings and 380 pupils on the first floor or an average floor-space to each of nearly seven square feet. Two recitation rooms, each seventeen feet square have usually ninety pupils each or three and one-fourth square feet floor-space and thirty-eight and one-half cubic feet per head. The stairs are badly shaped; there are some good ventilating flues. There are five rooms on the first floor with glass partitions, of these, three have no wardrobes and two have each a closet four feet square.

Tenth Ward School No. 1 is nearly like that in the seventh ward. The main study-room is entered directly from a wooden stair-room which forms a kind of postscript to the house, one such stands at each front corner, and they are as dark and steep as in the seventh ward. Stove heat seventy-eight degrees in both stories. Four tin ducts (3 x15 feet) for ventilation draw tolerably well; dependence chiefly on windows. The house is about as dark as the preceding; it has no cellar but a sub-floor space; it has no garret, and the ceiling of the second story is plastered on to the roof timbers. The yard is very muddy in rainy weather; when seen there were large puddles, one of which ran over the floor of the girls' privy. Both of the privies were sad sights, but the boys' especially so, with broken roofs, and walls built of bare boards without an attempt to fit joints, like an average country hog-pen; one hole for door and another for window; seats as inconvenient as possible. The attendance in the first story is two hundred and ten, (average) number of sittings one hundred and eighty; floor-space per head eight square feet; primary grade, second story, one recitation-room six and two-fifths square feet floor-space per head; children ten years old.

No. 2, *Tenth Ward,* is on very sloping ground (slate rock crops out) on the bluff. It was built in 1876. The lot is long and narrow. Of three stories two only are in use; one with two hundred and two, and the other with one hundred and forty-five in attendance.

There was plenty of light from twelve side windows in each room. The third story has tin flues in party-walls drawing well. The first and second stories have brick flues in outer wall drawing well in first story, not at all in second. The privies have vaults which were thought to be tight, but that is doubtful; they are nearly on a level with the second story, owing to the rise of ground, and about twenty feet distant. When the house was built a well was dug just in the rear which furnishes an abundant supply of water. The latter, however, soon became impure, owing to the neighborhood of the vaults, as was thought; it was discontinued, but the adjoining end of the cellar still receives a large inflow from some spring (at x on plan), which has to be carried off by a tile drain.

The following diagram shows the relation of the privies to the well and house.



School No. 2, Tenth Ward, Troy.

(X water enters house by spring.)

Eleventh Ward School. This is not so crowded as some. There are two hundred and thirty-four sittings ; one hundred and seventy pupils on the first floor. The recitation-rooms averaged six or six and one-half square feet floor-space per head ; others more. Clothes are mostly hung in the large rooms. The stairs are narrow and winding ; rather insufficient. The temperature ranges from seventy-three degrees to eighty-one degrees Fahrenheit. The ventilation flues used are nearly worthless; a disused chimney has not been applied as it might be with profit. The floors and wood-work are old and worn. The privy vault receives waste from water-taps in the house, which have traps beneath; it is professedly tight, and is washed out twice a week with a hydrant into a sewer.

Thirteenth Ward School, seen after hours. Average attendance six hundred. A recitation-room, eighteen by eighteen, averages seventy or eighty primary children — a trifle over four square feet floor space per head. Height, twelve feet. The stairs are badly curved. The house was found close even after school hours. There were only fifteen seats in the privies.

Public Schools of Lansingburg.

The town contains four two-story brick school-houses with a total registered attendance of 950, and a seating capacity of 1025. All are in good repair and keeping. One of the lots is liberal in size. Over-crowding does not exist in any excessive degree. One school has sufficient space. The houses and inmates are cleanly ; the clothes-room sufficient ; a roller towel hangs in each school. One house uses filtered rain water and one has a driven well in the cellar ; the others use pumps.

The plan of these schools retain the feature of one large study-room. In two of them, however, a former large room has been divided by a partition, making two good class-rooms. The new school has simply four equal sized class-rooms, without recitation-rooms. The stairs are solidly built, with one turn and a wooden partition instead of well and rail. Vaccination is not enforced. Children from the house where contagious diseases are known to exist are excluded ; but for information in regard to such cases, teachers rely on their own exertions, without assistance from the Board of Health. Very commendable efforts are making to improve the ventilation by window-boards and flues. The privies are fairly clean, but of the old-fashioned sort. The soil is a gravelly loam, pervious to water ; and the propriety of retaining privies is distinctly questionable. The privy at the Market street school is altogether too near the house to be safe ; a vile odor in one neighboring room of the school is complained of, of undefined origin, perhaps referable to the cellar and soil pollution.

Whipple Street School.— Primary and intermediate grades. Floor space per sitting ten superficial feet in main and recitation-rooms. Lighting not quite perfect ; glass about $\frac{10}{77}$ of floor-space and trees in the way. There are four flues of brick which are capped with tin tips and the Globe ventilator. They draw pretty well from the first

story, but the air passes through them at more than one place from the first to the second story. (A match lighted at a lower orifice was distinctly smelt at the inlet in the story above, in two of the flues.) The ventilation is complained of as poor.

Market Street School was built in 1847 and has since been altered. It has four large rooms on the first floor, with space per head of 12, 12, 11, 12.6 square feet respectively, on the basis of seating capacity. On the second floor 72 pupils averaging nearly fifteen years of age giving less than 9 square feet to each pupil in attendance. There are tin ventilator pipes, of the combined sectional area of 500 square inches acting well (some of them remarkably so.) They go straight to the roof and have simple caps. The worst ventilated room is one with flues discharging into a garret, with a cap on the ridge-pole. There are well-founded complaints of bad air in the school.

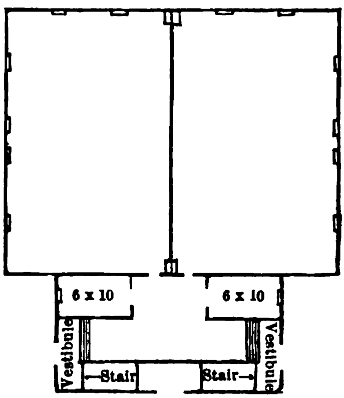
Fourth Ward School (Primary and Intermediate). The house is ten years old. The main room has 19.4 square feet of floor space per head, on the basis of actual attendance; 12.5 on that of seating capacity. Two recitation-rooms, 12x15 feet each, contain classes of fifteen pupils = 10 square feet each; one room up stairs, 35 small children = $7\frac{3}{4}$ square feet each. Ventilation decidedly bad, — the worst of the schools in that respect; no flues, except two which are nearly closed and discharge air into the unfinished portion of the second story which has a musty smell in consequence.

The Diamond Street School deserves special mention. The lot is liberal in size (120x150 feet) and neatly fenced; the privies 60 feet from the house in different directions. The house-doors (three, leading from one hall) open outwards. The clothes rooms, one to each school-room, measure 6x10 feet and are light and airy. The finish of the hall and the wainscoting of the rooms is in wood. The windows number six in each room, each $8x2\frac{3}{4}$ feet, or, allowing for sash, about 120 square feet of glass in all which equals $\frac{1}{6.5}$ of the floor-space. They are placed so high that there can scarcely be two inches between the frame and the ceiling and this is accomplished without iron girders. The house however is not heavy and has but four rooms. The proportion of the latter are good and the floor-space equals seventeen square feet to each sitting in three primary rooms, and 24 in one intermediate room. This with a height of thirteen feet gives the ample allowance of 221 and 312 cubic feet of space per head to the primary and intermediate grades respectively. The window sills are four feet above the floor, but this does not seem to injure the appearance of the rooms.

The drinking-water is taken from a cistern in the rear of the house which receives and filters the discharge from the metal roof. The school-rooms contain wash-stands for scholars' use. "Those who come with dirty faces are obliged to wash them," and this mild form of punishment is effectual in preventing a repetition of the offense.

Two self-feeding jacket stoves in the cellar (which is a pattern of neatness) with inlets $1x2\frac{1}{2}$ feet in section warm the house. There are two shafts for ventilation, placed between the rooms. Each shaft has three flues; one 12x12 inches for the smoke of the furnace and one on each side of it, each 12x16 inches for ventilation. Thus there are four ventilating shafts with a total sectional area of 1,408 square inches, finished tolerably smooth inside and going clear through the roof. There was a very powerful draft at the inlets in the lower rooms but

the shafts are each tapped twice and the inlets at the upper rooms do not draw so well. The inlets are placed at the floor, are 16 inches square, without valves, and guarded by wide meshed wire netting. The windows are double throughout which furnishes a very safe auxiliary to the ventilation.



Diamond St. School, Lansingburgh, first story.

PUBLIC SCHOOLS OF WEST TROY.

The public schools in this place are not in a promising state. Public interest does not seem to support them. A very large number of children are employed occasionally in market gardening, and the attendance is apt to vary widely from the registration. There are several important private schools; and many children, besides, go across the river to Troy, or to other towns, to school. The buildings, with one exception, are old and rusty; several of them are quite unsuited to their present use, and two, at least, should be abandoned entirely. As a rule, the privy vaults leak freely into the soil; urinals are not provided, and the separation of the sexes is not sufficiently attended to. A case of contagious disease excludes the remaining members of a family from school.

The First Ward has two school-houses. The larger one is of brick, about 12 years old. The scholars are of the poorer class. The rooms are close and poorly lighted, (window-surface 1-12 of floor-surface). The clothes are kept in close, small closets, and in the seats. There is a certain desk which possesses the power of making a startling clatter when its hinge-joints are put in operation. Gymnastics are sometimes practiced "to keep warm." The privy has not been cleaned out for five years. There are 300 enrolled pupils, and an average attendance of 150.

The smaller house has on the first floor 108 little scholars with 82 sittings. They sit all together in a room 27 feet 6 inches wide, 31 feet 2 inches long, 12 feet 6 inches high; the cubic space per head is a trifle under 100 feet; floor-space 8 feet. Ventilation almost impossible without dangerous draughts; the air was very bad; thermometer 77°. Everything in the room (except the inmates) was antiquated and odd. The second story has one rather larger room with 60 older pupils.

"They are allowed to move at once, whenever they feel cold." Open windows keep the room comfortable. The water for both houses is brought from a pump in the road, which must be 130 feet from any privy. The privies are deficient in accommodation, and consist of one house with a board partition; there is no partition in the yard; the children from both houses play in the street at recess for want of room in the yards.

In Ward 2 there are two houses. The primary school-house is an old wooden structure of two stories. The yard is small. The room on the lower floor is 27x23 feet, and only 9 feet high. Before entering the house, the frequent sound of coughing was heard, proceeding from this room. Within, the room was found packed, more than a hundred little creatures about the age of five, heaped together, as it were, evidently coming from the poorest classes. The attendance varies from 100 to 122. The stove was briskly at work; the windows were freely opened, throwing draughts upon every child's head; the teacher said that if this was not done they all had headache. The greater part of the children seemed to have colds. The floor was wet; this was explained to be due to the practice of squeezing out their wet slate-rags on the floor, which is encouraged, "in order to lay the dust." There are no mats or scrapers, and the house is so old that dust is a very probable circumstance concomitant. The cellar is perfectly dry and extends under the whole house. The second story is not quite eight feet high, and averages 56 pupils; a very comfortable room in comparison with the other. The stairway is only 32 inches wide, and the hand-rail makes the space still narrower, say 2 feet and 2 inches wide. House entirely unfit for its present use.

The larger school-house has a muddy, low, undrained yard, without separation of sexes, and a privy in a disgusting state. The stairs are too steep. The air is kept good in the rooms by opening windows.

The Third Ward School is new. The first floor contains two rooms, each 21x43 feet and eleven feet high. The seats and attendance are respectively 76–92; 96–76; showing a discrepancy in both directions. The teachers said that this was unavoidable, owing to the inequality in different classes. Cubic space per head, 106 and 132 feet, respectively. The recitation-room receives classes of from fifteen to forty children giving allowances of from forty-five to one hundred and nineteen cubic feet each. In the rear there is a clothes-closet, or rather two closets with no partition; in each, the boys use one wall and the girls the other to hang their clothes. The yard is divided by a fence, but is muddy; the privy is one house with a board partition. The floors are said to be cleaned once a year. The ventilators work both ways. The cellar is hot and close; and contains great quantities of ashes. A certain part of the cellar floor is occasionally used as a privy of the pre-historic type. The janitor sweeps his dust from the house directly down into the cellar, and keeps it there. At the time of the visit, the air in the house smelt of gas from the furnace.

The Fourth Ward School is in an old brick house, which looks like a barn; and the internal structure does not belie the promise of the outside. The sweeping of the floors is imperfectly attended to twice a week, and the appearance of the room corresponds with that neglect. The desks are very old and badly hacked. The room on the lower

story is ten feet in height, that on the upper story nine feet; the ventilation of the latter is much complained of. The first floor room (25x20 feet) registers ninety, with an attendance of fifty-five or sixty; the second floor room is larger and has an attendance of forty-five or fifty. The house is evidently not popular in the neighborhood. Four large private schools attract a very much greater number of pupils than are found in this. The pump is at the street corner, probably not within fifty feet of a privy.

PUBLIC SCHOOLS OF GREEN ISLAND.

Watervliet District No. 23 ("Green Island"), contains two schools. No. 1 is about twenty-five years old. No. 2 was built last year. A great unwillingness to open the windows is characteristic of the district. No. 1 is heated by three furnaces in the cellar, which draw a considerable part of their air-supply from the cellar. The air entering the room is at 126°, and that in the house is decidedly hot, one room being at 77°, another at 79°. The rooms are rather crowded; two had respectively nine and ten square feet of floor-space per head. Each room has two or three ventilating exits, usually acting well, but much improved when the door was opened.

The plan of No. 2 is very similar to that of No. 1, with broad entries, four rooms to a floor, good clothes-closets in the entries. The house is heated by direct radiation from steam coils. The building was visited at too late an hour for complete inspection.

SCHAGHTICOKE (HART'S FALLS) SCHOOL-HOUSE.

There is much malarial intermittent fever in this place, and many of the children suffer. However, the site of the school-house does not, apparently, contribute to this result; it stands on a steep bluff, very high above the river, and the natural drainage is good. The house is six years old and stands in a large lot, neatly laid out with grass and trees. There are 250 sittings and an average attendance of 165; as is frequent in such cases, the air of the house seemed good. Certainly this was so in the second story, where there were *present* fifty-five pupils in two rooms with a united floor-space of 2,128 square feet—nearly forty square feet apiece, or 538 cubic feet apiece. The *desks* number 126 in this story. The lower story, being much fuller, was rather close. Air passes from each room by one register near the ceiling; the rate is good, but one flue is not enough, and when the house is filled this will be perceived. A clean cellar is used for an evening school. The water comes from a well, quite remote from privies. The house is a good one, but the recitation-rooms are quite small (16x19 1-2 feet) and unventilated.

HOOSICK FALLS SCHOOL-HOUSES.

The hours of school are nine to twelve A. M., and quarter past one to half past three P. M. Primary scholars are dismissed at half-past two. There is a recess in the forenoon, but none in the afternoon; the omission seems to be considered a gain in respect to discipline, and does not deprive a child of the right to leave the room when necessary. The primary and intermediate grades practice gymnastics five minutes, both forenoon and afternoon.

Half-time was tried last year for twelve weeks with a class of 100 children in the lowest grade. A single teacher instructed one-half of the class in the forenoon, and the other half in the afternoon, giving three hours to each half. The progress equalled that which is usual.

Three buildings were visited.

The Academy is a two-story brick house on high ground, with a steep rise in the rear. In each floor three rooms belong to the old part and two new rooms project as wings. The latter stand free on three sides, and have shafts with rather powerful exit-currents on two sides; they may be considered as satisfactory. In the old rooms there was a general closeness, occasional excessive heat, some defective lighting, and some crowding. One room had fifty-six pupils (all present!) of the age of ten years, upon a space measuring 13 1-2x39 feet. The cubic space per head is eighty-nine feet; it is almost impossible to ventilate the room and the heat is excessive, but in the want of a thermometer in the building, 82° was guessed. The room is 9 1-2 feet high.

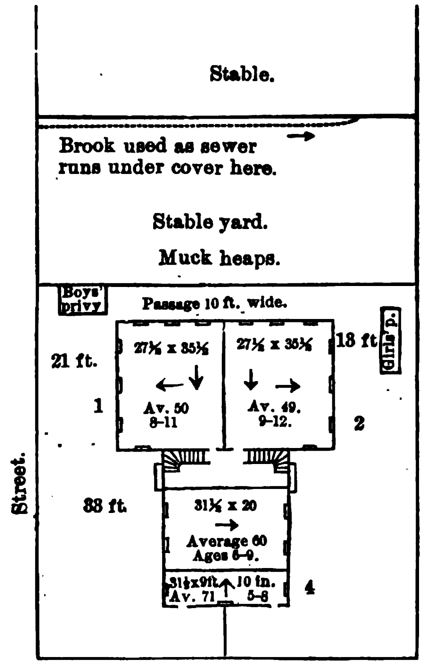
In two other rooms the cubic space was 77 and 110; ages of pupils, about twelve and eleven, respectively. The privy contains no seats; its floor was filthy, and so was that of the other school-house, also. A pump in the cellar supplies drinking-water.

The new school has two floors and two rooms on each. The most crowded room allows about 160 cubic feet per desk; the house is not full. In one room, certainly, the light is insufficient; for two out of seven of the windows are in front of the pupils, so that the blinds have to be closed, and the remaining five equal only 1-14 of the floor-space, and are too far from the ceilings. There are five ventilating holes in each room, which do not act; they are circular, eight inches in diameter, communicate with spaces in partitions, and all discharge ultimately into two brick flues, each one foot square, which constitute the exits for the entire house, with about 250 inmates. The water-closets were originally placed in two small contiguous chambers in the cellar, containing three pan-closets each, which were reached by one stairway through a very dark cellar. The boys' closet, however, had to be abandoned on account of the smell, and a wooden privy was built, forty feet from the house, with seats quite too high. The yard is not divided.

Two rooms are hired for school uses in a business block, upstairs. The rooms themselves are not objectionable, but there is no place for play outside.

Public Schools of Peekskill.

The village of Peekskill contains two school-houses of nearly equal size.



[Plan of Union School premises.]

The Union School-house. The site is low, as regards surrounding grounds, and difficult to drain. Water often stands in the cellar. The lot is one hundred feet square; one-half of all the open grounds is fenced for the girls; the other half is without fence, and is muddy. The adjacent ground, eastward, is a stable-yard, with heaps of manure near the school-grounds; a little brook runs under the further edge of the stable-yard; it receives the sewage of a group of houses, and is often stagnant and offensive in summer. The stable is only fifty-five feet from the school-house. There are two privies; that for the girls is thirteen feet from the house; is old, and smells badly. That for the boys is about three feet from the house, and its seats are unsuitable; the floor was found clean (it was an "exhibition day"), but there was information that the usual state is far otherwise. It has only recently been removed from the spot marked ooo on the diagram, where the side of the school-house actually formed one of its four walls. Each privy has five seats, giving about a third of the accommodations needed by an average attendance of three hundred and thirty-two (enrolled, 430).

The school-house is of wood, two stories high; the first story nine feet nine inches to the ceiling, the second, twelve feet. It is about thirty or forty years old, and is in appearance an average back-country district school-

house, magnified in dimensions. There are a good many large windows, and in most of the rooms the light is tolerable, or sufficient; but where the children face the windows (as in the master's room, No. 1 up-stairs), blinds have to be closed, and a deficiency exists. The interior is old and worn; new floors and some new furniture are desirable. The floor of room No. 1 was very dirty and neglected. The mud is brought in by the children after playing in the yard and streets.

The ratio of density of this school population, is given in the following table:

Story.	Room.	Number of pupils.	Ages.	Floor, sq. feet.	Room, cub. feet.	Floor-space per scholar.	Cubic space per scholar.
2	1	15	14–17	957	11,484	63.8	765.6
	2	40	10	957	11,484	23.9	286.8
	3	25	to	465	5,580	18.6	223.2
	4	42	15	465	5,580	11.0	132.0
1	1	50	8–11	957	9,331	19.0	186.0
	2	49	9–12	957	9,331	19.5	190.0
	3	60	6–9	624	6,984	10.4	101.4
	4	71	5–8	306	2,983	4.3	42.0

The disproportion is enormous between the amount of space allowed for the different classes. The room which stands at the foot of the list is far the worst. It was formerly a lumber-room, and has been converted to its present use very recently. The attendance in this room varies from 35 to 80. It is simply impossible to ventilate it properly without causing dangerous draughts. Nothing in the way of assisting ventilation is done in the entire house, except by opening windows; and they were found open here also. The room is less than ten feet high, and less than ten feet wide; draughts and colds are prevalent, and the visitors found, as it seemed, one-half of the children coughing or sneezing.

There are four stoves on the first floor. One is a small one, for the sole use of the room just mentioned. The others stand in the other rooms, each provided with a jacket for the purpose of collecting the foul air from said rooms and sending it up through a pipe to warm the rooms on the second floor, which have no other means of heating. In one of these upper rooms the teacher said the children suffered much from headache.

Upon a rough estimate, nearly twice the present number of children under sixteen require accommodations in the public school of this district. A new house is urgently required under the present circumstances, which are most obviously imperiling the children — at one end by over-crowding and cold draughts, at the other end by stench and soil-pollution, and in all parts by dampness of site and foul air within the house.

Drum Hill School-house enjoys one of the most charming views to be had in the region of the Hudson river. It stands on a high rocky elevation, far above the village. The number of pupils is about the same as in the other house, but their lot is a more agreeable one. It is of brick, two stories in height. A large addition is now making, inclusive

of a widening of the hall and staircases. The lower story in the older portion measures 63 feet 8 inches by 22 feet 8 inches within walls, and is divided telescope-wise into three rooms, containing 200 pupils. The freedom of circulation of air, due to the elevated site, and the comparatively open (non-compact) plan of the house, aid much in securing good ventilation, for which no sufficient provision is made in construction.

Yonkers City Schools.

In this city the two large and one of the three smaller houses were visited.

School-house No. 2 is of brick with three stories and a cellar. The land is 100 feet above tide-water at the middle point of the school, and slopes so rapidly that there is an exit directly to the ground from each story. The space is ample; the soil rocky, in part covered with gravel.

The main building contains 21 rooms, 925 sittings, 117,788 cubic feet of space in study-rooms, and a total average of 127 cubic feet per sitting. The primary rooms, as usual, were the fullest, four such having about 9 square feet apiece of floor-space per sitting. An epidemic of measles had drawn off about 400 of the scholars, and the "annex" (two rooms in a neighboring wooden house) had been closed.

One primary room has about 3 3-4 square feet floor-space per head, viz.: 104 seats and 384 square feet floor (24x16). This room is dark, and when the school is at a normal standard, extremely crowded and close.

Six rooms besides the last named have defective light, the window-space being from 1-8 to 1-9 the floor-space. There is no general attention to the principles of lighting. The house has no blinds, cloth roller shades being used in some south rooms. The desks are not ideal, but a graduation (three sizes to a room) is to be commended, and also a correct distancing of seats from desks. There is an abundance of places to drink and wash, and one room (20x40) with good light, warmth and cement floor for the girls to remain in and eat a noon-day lunch. The cellar is good and dry; it contains four furnaces. There are three jacketed furnaces and one base burner in the second story. The clothes are hung in the entries. The privies are in good order, no sewerage, simple cemented vaults, distance 35 feet from house. It is desirable to substitute some other arrangement.

The house has nine outlets, all by doors opening outwardly. Two short corridors run across the whole width; one long one nearly the whole length. The circulation of air is probably facilitated by this arrangement. In most of the rooms the atmosphere was fairly good. Windows were freely used, however, and doors and transoms were all open to corridors. The outside temperature was 37° F.

The ventilator register in the west rooms (four in each room each 8'x12') open into hollow walls and the air is presumed to discharge into the attic. From the latter three pipes, eight and one-half feet in circumference, open upwards into the open air. The current in many of the above registers was not good. The chief complaint in regard to ventilation in this house proceeded from certain rooms which are rather long and narrow (17'x27') with only two windows placed opposite the door so as to be most remote from it. In the rooms which had no flues this complaint was not heard; these rooms are surrounded on three

sides by corridors and the fourth side has four windows. The singing of the school in common and the teaching of music and reading deserve very favorable mention.

The "Annex" consisting of two rooms in a wooden house near by of the dimensions of 38'x18' floor and 7½' and 8' respectively in height. Cubic contents of first 5130; pupils (I primary) 50; seats of second, 5470; pupils (K primary) 90; seats, 94. The floor-space is accordingly 12.7 and 7.3 feet apiece, cubic space 95 and 57 feet apiece in the two rooms, respectively. The low ceilings, defective light, and absence of ventilation combine to make these rooms undesirable especially for such close crowding.

No. 6 registers 621 pupils in eighteen class-rooms. The site resembles that of No 2. In respect to size of rooms, floor-space per head of actual attendance, opening of windows and doors, size of ventilator flues and registers, No. 6 has a little the advantage or is not inferior to No. 2. The house is heated by six boilers (steam) the coils being placed in the cellar under the points where heated air is to be distributed to rooms. The air of the house was found generally inferior to that of No. 2. Perhaps the side of the corridors may be an important element in this result there being but one in No. 6 and that closed by double doors at each end.

In two crowded rooms formerly noted for poor air, a tin pipe open at floor and ceiling, heated by two Argand burners and carried far above the roof, seemed to act successfully. The comparative purity of the air was at once noticeable. It is said that the tube receives 900 cubic feet of air per minute from each room. The windows and doors were closed for twenty-five minutes without greatly increasing heat or closeness.

The cellar is under-run by the house sewer which starts at the water-closets situate at one end of the building in a porch. These closets and their surroundings are highly commendable. A little freer access to the places under the seats and a little less wood work might be desirable; also some readier way of disposing of water used in swabbing down than that of pushing it out into the yard with a swab. As a change from the old arrangement of water-closets under the house the new is every way desirable.

The house is dry the cellar being properly under-drained.

The children's clothes are kept in named closets in the school-rooms as in the New York schools.

Union Free School No. 1 has one class-room and about fifty scholars. Above it is a similar room for public performances. It has a good roomy vestibule, a large library room, two good stairs, a model cellar with good hot-air furnace, cistern for drinking. The class-room is spacious and high and prettily decorated. Unfortunately it must be added that the site is low and in the centre of a malarious region though there is no dampness about the house and no cases of fever can be traced to its influence and also that the cost of erecting was $9,000.

The city has an ordinance passed in 1877-78, requiring every practicing physician and surgeon under penalty of fine to report to the Board of Health the cases of contagious diseases occurring in his practice. Much opposition was made to the passage of the law. The reported

cases, however, are not brought directly to the notice of the school authorities as they should be. Cases of such disease, and all children residing on the same floor with cases are alike excluded from school, until a certificate of fitness to return to school is given by the physician. The fact of vaccination is recorded on the school register.

PUBLIC SCHOOLS OF NEW ROCHELLE VILLAGE.

At this place there is one large brick school-house with five hundred and fifty-one registered pupils, and two smaller schools of one room each, which present nothing of special interest.

The large school occupies a very beautiful site — two acres of land falling rather rapidly in the rear, embellished with fine trees, seats, and a flower garden. The premises seemed to be under the protection of the scholars.

The house is about twenty years old, and has faults in its plan. A newer portion has imitated the style of the older. It is somewhat crowded. There are eleven rooms, one for each grade, and one large assembly room. Of the class-rooms, one has twenty square feet of floor-space per pupil. The others have from 6.7 to thirteen, with an average actual attendance of forty-four to each room. The rooms are of the height of eleven and three quarters feet, and twelve feet. The light is deficient in some rooms, and badly distributed in others. There are four in which the windows are twenty-four feet from the opposite wall (and on one side only). The ratio of glass to floor-surface is one-thirteenth, and they are justly complained of as dark — two of them also as close.

There is no ventilation except by opening windows; in cold weather window boards are placed under the sash. The house is heated by three furnaces in the story which may be called either cellar or basement, a story which is uncovered by the slope of the land in the rear. The youngest class of children still occupies one room in this story; a sub-floor space under this room is the source of supply of fresh air to a jacketed furnace which warms this room, and the two above it. No complaint of dampness was made. There are good sized play-rooms in this story; it is about eight and one-half feet high, and not wholly satisfactory as a plan for school work.

One stair is very good, the other one (frequently used and liable to be used in an emergency), is only two feet wide, and has sharp turns; it can hardly be approved. The doors of exit from the house open outward and are sufficient.

Light gymnastics are confined to the primary grades, once a day in the higher, twice in the lower. The school is neatly kept and orderly. The drinking water is from pumps near the house, one hundred and forty feet from the privies, and in all probability uncontaminated. The privies are about forty, eighty and one hundred feet from the house. They are properly cleaned, but the vaults are offensive; one of them has not been cleaned out for three or four years. A board fence cuts the play-ground in two.

Respectfully submitted,

JAMES G. HUNT, M. D.,
Chairman of Committee.

NOTES AND CONCLUSIONS

UPON THE RESULTS OF THE INSPECTION OF SCHOOL-HOUSES UNDER THE COMMITTEE ON PUBLIC INSTITUTIONS, AND UPON DR. LINCOLN'S REPORT ON THE PRINCIPLES AND PRACTICE OF SCHOOL HYGIENE.

The results of personal inspection are found to harmonize quite generally with the replies which have been sent in by school district officers relating to the health questions submitted by this Board in circular No. 35. These results of the inquiry, by means of the circular to school officers, are yet incomplete. They will be studied advantageously at the expiration of another year; for over 11,400 school districts in the rural parts of the State are day by day making their returns upon the questions of that circular.*

The conclusions reached by the committee, and by Dr. Lincoln who labored with it for a period of three months, are briefly summarized as follows:

1. Structural improvements are being made in the school-houses in many districts; there is a recognized attention to some of the requirements of health that have been neglected in the old school-houses.

2. The committee has found only about one in fifteen of the common school-houses well outfitted for protecting the health of the pupils. Even in that one, there is oftener a neglect of sufficient ventilation than a suitable provision for it.

3. As a general fact, ventilation in the common school-houses is insufficient, and the means for it badly designed. When good, its excellence depends chiefly upon open windows and special facilities for controlling them.

4. Over-crowding is a prevailing fault, and even a wrong, in a majority of the school-houses which the committee and Dr. Lincoln have reported upon. The exceptions to this rule are noticeable in some of the diagrams printed in the report. In many of the schools the over-crowding is such as to endanger the health and life of the children, and taken in connection with defective ventilation, is a matter of momentous importance to the most loved and valued of lives in the families that send their children to the common schools.

---

* The preceding report by the Standing Committee on Public Institutions, presents notes and illustrations from that committee's inspections.

5. In numerous towns, villages and cities, as shown in the report, there is a disgusting, degrading and harmful neglect of sanitary cleanliness in and about the school buildings, especially as regards the privies and the means for the proper separateness and convenience of the sexes in relation to these matters.

Such neglect of cleanliness and decency should be interfered with and prevented by local sanitary authority. The public health, the bodily welfare of the children, and their moral safety alike require that this duty shall be attended to promptly, and by peremptory orders wherever necessary.

7. The supply of drinking water for the common school children is much neglected, excepting where hydrants, from the public water service, exist upon the premises.

8. Wardrobes or rooms, with pegs or brackets upon which to suspend outer garments and wet clothing, are seldom found suitably placed, and often they are neglected altogether.

9. Hand-basins, wash-stands or lavatories are wanting in a great proportion of the common school-houses.

10. The experiment of omitting the old practice of school recesses between the noon hour and the opening and closing of school, is being extensively adopted with doubtful — probably injurious — results.

11. The recreations needed by school children, under the name of light gymnastics or play, are confessed to be of great use to the younger classes in the common schools; but it is found that the people do not suitably appreciate such physical exercises. It is desired, therefore, that teachers and parents should more thoroughly understand the reasons for encouraging and perfecting facilities for them.

12. There is found to be special reason for urging that girls shall not be deprived of the means of health which innocent and regulated gymnastics afford.

13. There is much neglect of, yet an increasing attention to, school seats and desks. This subject is found to need even greater attention than it is receiving.

14. The permanent injury to the eye-sight of school children is so frequent, and yet so preventable, that the known causes of such harm should be ascertained and provided against in every school. The proper lighting of the school-rooms, the best adjustment of seats, desks and black-boards, and the necessary regulations of study and exercise should be secured under competent medical advice, in which in every new or remodelled school-house the most approved lighting and the best arrangement of seats, desks, etc., for the protection of eye-sight, and for the general welfare of the pupils, should be provided.

15. The reception of vaccination by school children, under direction

of their parents and the school officers, is found to have nowhere produced inconvenience or serious dissatisfaction. It seems eminently desirable, and certainly practicable, to secure general compliance with the statutes relating to the vaccination of school children as now administered under advice of the State Board of Health. (See circulars Nos. 17, 38 and 41.

16. There is an obvious necessity for the promulgation and adoption of sanitary rules and regulations for the protection of health and life in schools as now recommended by the Board. (See circular No. 41.)

DR. LINCOLN'S REPORT ON THE PRINCIPLES AND PRACTICE OF SCHOOL OF HYGIENE.

As the Board has, for many months past, found it necessary to have at hand ready replies to practical questions which arise in almost every school district, and especially where there are outbreaks of contagious diseases, overcrowding of schools, high death-rates in particular schools, or new questions that have to be discussed and settled where school buildings are to be constructed or improved, this Board has directed that Dr. Lincoln's special report shall be added to the foregoing conclusions in order to supply such information as is herein given with ample illustrations and examples.

In offering the foregoing conclusions, together with the special report of Dr. David F. Lincoln, relating to Sanitary Requirements in the Common School-houses of the State, this Board, at its quarterly meeting on the 8th of February, made the following minute of its reasons and order for reprinting and separately distributing this part of its Second Annual Report:

"WHEREAS, School officers of numerous districts in the State have applied to the State Board of Health for suggestions concerning the proper sanitary arrangements for school-houses, therefore,

"*Resolved*, That the conclusions derived from the report of the Standing Committee on Public Institutions, as regards school hygiene, together with the recommendations in Dr. Lincoln's special report on the subject, are hereby adopted by this Board and ordered to be reprinted from the Annual Report, for distribution to School Commissioners and the proper School Officers."

This document will be known as No. **43** in the series of the Board's publications, and it is earnestly commended to the attention of the people, who have upwards of a million of their children in attendance in the common schools of the State.

EDWARD M. MOORE, M. D.,
President.

ELISHA HARRIS, M. D.,
Secretary.

LIST OF ILLUSTRATIONS.

REPORT UPON SCHOOL HYGIENE.

BY D. F. LINCOLN, M. D.

NOTE.—During the course of the inspections which have been made under the direction of the State Board of Health, the writer of these pages has had opportunity to observe the actual condition of the school buildings in many widely distant places in the State of New York. The present paper is based chiefly upon these observations, and is intended to supplement the detailed accounts given in the Standing Committee's report, by adding a statement of general principles, adapted to induce the correction of existing defects.

INTRODUCTORY.

A human being, considered by itself, is a unit, and has value as such. In combination with others, it forms a part of a compound unit, a larger being, different from any of the individuals composing it, and endowed with special productive or destructive powers. But every thing has its price; and the gain is associated with a loss. The man who forms part of an association gives up some of his own individual rights. Tied to a machine, he becomes a part of it. Does the child lose any thing by being incorporated in the system of common schools? Doubtless he does.

A child who enters a public school is conscious of a change in his surroundings of which he cannot give an account, but which constitutes for him a new world. He has ceased to be an individual, and has become a fractional part of a machine. He has been well understood by persons who have watched him from his birth, and who are deeply interested in his person. He is now transferred to the care of strangers, who meet with him only five hours in the day, and whose interest in him is restricted by the fact that he forms but a fraction — say from one and one-tenth to two and one-half per cent — of the total group of children that is intrusted to the care of a teacher. He is held by the teacher a few months, and then passed on to another, again as a

fraction, not as an integer.* Does he not lose much, as well as gain something, in this system?

As regards his health, he loses that defence which the sympathy of the community always extends to an individual who is suffering conspicuously. Taken generally, all children in school are suffering some discomfort. Average the discomfort among ten thousand, and it may not be very great for each one. But a class of fifty children is not made up of fifty *averages*. Let us imagine such a class, containing among its members representatives of the common affections of school life, such affections and complaints as the writer of these lines has frequently had to encounter among the children in public schools. Individual number one has a ravenous appetite, sleeps soundly, works little, plays much. Number two is a little pale, eats less in term-time but recovers his appetite each vacation. Number three is detained at home occasionally for headaches, caused by poisonous carbonic oxide and carbonic acid gas, from the stove, or by the foul air of the crowd. Number four mutters arithmetic in his sleep, especially just before the annual examinations for promotion. Number five occasionally sits in a draught of cold air, and catches cold; while his next companion has a tendency to catarrh of the ear, and is gradually becoming deaf under the discipline of a school which confines him to one spot. Number nine is a child whose parents are near-sighted; he sits in a corner of a dark room, where light is insufficient, for writing in the winter season; he is allowed to sit in an attitude that brings his eyes within three inches of the book, and he is placed in a desk which is so high and ill-adapted as to prevent him from holding the object at a proper distance. He is complained of as dull, listless, inattentive to what is written on the board, when in reality he is shut in upon himself by the fact of near-sightedness, which condition is aggravated every day by the way his education is carried on. Number twenty has just recovered from the measles, or perhaps we should rather say, is convalescing — for she is a little pale and weak, her eyes are not strong, and her eager nervousness hints at the reason for her premature return to study; she wants to be present at an examination, on which her "promotion" will depend.

Numbers thirty and forty-one wear glasses; one pair has been placed on the child's eyes by the most accomplished medical skill, for the relief of far-sight; the other has been picked up from a tramping pedler.

Now the classes are ordered to write. They begin in form; but in three minutes' time their heads are bent within an average distance of

*It would be very unjust to many faithful teachers to present this as the universal fact. There are many exceptions, local and personal; but the general tendency remains as stated.

three inches from the copy-books; and a distorted position of the body is inevitably produced by, the faulty shape of the desks. These scholars, the teacher says, write about twenty minutes a day, and that cannot be long enough to inflict any permanent injury. But in another room they are adopting the "Quincy method," and the scholars write a good deal more; and in the upper classes they write long translations and compositions, and copy out lectures.

In another room may be seen a class of girls and boys of about fifteen or sixteen. They pass in file, and there is opportunity for seeing that not one in ten of the girls has an erect figure; many stoop painfully, and among forty whom the eye reaches, four or five appear to be deformed with lateral curvature of the spine. Here is a tall young woman, who sits, like others, with the upper part of her body across the desk in an attitude of fatigue. She is an overworked person, and the school is not wholly to blame for that. But the school may be responsible for the ill-shape of the back of her chair, which gives her no real support in sitting, and compels her to lean forward instead, to relieve a pain in her back.

Such facts as these will constantly meet the eye of one who visits our common schools and studies the health of their inmates. And is there not an inference from such facts? Are they, perhaps, of that class which imply a duty and a responsibility? Human life is the best of human possessions; and the best part of life is the hope that we are leaving behind us those who will be more able and worthy to enjoy it than we have been. These successors of ours are the children. Can any thing touch us more closely than the thought that there is a group of influences, manifold and wide-spread, which are constantly acting to lessen the worth of their young life?

This is a complex field of study, for it includes at one end the details of certain branches of physics and engineering, and extends on the other to questions regarding the powers of young minds, the means of developing without straining them, and the precautions against injury to the highest of the senses. However tempting this field, it is necessary here to limit our scope to the principles and details of what may be called "sanitation" in the most limited sense of the term. In other words, to attempt an answer to certain questions which are most frequently and properly addressed to a board of health, considered as a sanitary counsellor of the people. Such questions belong under the general headings of ventilating and heating; lighting, and the care of eye-sight; planning of school-houses; school desks and seats, and other topics which cannot be fully dwelt upon here.

This paper is meant to be of use to those most concerned with the details of daily school life, with whom the writer has been in frequent contact, and to whom he is happy to acknowledge an indebtedness for many valuable suggestions.

Ventilation and Heating.

"How much?" and "How?" are the two great questions in ventilation.

Ventilation implies getting bad air out and pure air in. How much good air does one person need? Enough is needed so that a person coming in from the fresh air shall not notice closeness, or a smell of closeness. In a house permanently dwelt in, sixty cubic feet per minute, for each person; in a house occupied for short times and then aired out by sweeping draughts, thirty cubic feet per minute, or half a foot per second.*

If we wish to ascertain by calculation how much the ventilating arrangements of a given room are actually supplying, we had better limit the question at first to the point, how much air is *drawn out* or makes exit in each minute or second of time? Evidently, for each cubic foot of air taken out another foot must come in. It will be right to ask afterward whence the new supply comes, and what its degree of purity is. But in our climate rooms cannot be ventilated without flues, and if the flues are adequate to their duty all the air that leaves the room will leave through them. If the flues are weak and insufficient we may find, even in winter, that hot air will go out at an open window; but if they are large and powerful, we can open windows so that the air will come in forcibly.

Few people are aware how small a quantity of air is actually drawn out of apartments by ordinary flues for ventilation. By "ordinary" I mean the old-fashioned sort, of the size of one or two bricks, 4x8 inches, or something about that, with a close grating called a register to obstruct the current at the bottom, a sharp angle at the foot, the inside roughened by protruding mortar and with only an accidental opportunity of getting warmed by contact with a smoke-stack. You stand

---

The amount of fresh air required is the amount which is needed in order to dilute the impure air to a certain standard of relative purity. All good air contains a small proportion (4–10000) of carbonic acid gas; when human breath is added, the amount is increased. It is found by experience that when this increase brings the total amount to beyond 6–10000, the air begins to smell close. A person may, therefore, add two parts of carbonic acid to 10,000 of air before it becomes objectionable. If he should breathe out two feet of the poisonous gas in an hour he would affect 10,000 feet of air to this extent; but as the real amount expired in an hour is about one-third of two feet, he uses and renders unfit for use one-third of 10,000 feet, or (more exactly) 3,500 cubic feet of fresh air per hour.

in front of it with a light pocket handkerchief; the cloth is gently drawn toward the opening; it deviates a couple of inches; you say "it draws," and are satisfied. "The thing is working." Probably, in such a case, the rate at which the current moves is something like a foot per second. The flue is drawing out a quarter or a half of a cubic foot of air per second — enough, perhaps, for *one person's* requirements. A large schoolroom may often be seen provided with half a dozen or more of just such ventilating flues, which are considered to be "the correct thing," and are pointed out to the visitor as the evidence of good ventilation in the house. Evidently the question of "How much?" is of leading importance in some other matters than those of finance and trade.

It is strongly to be recommended that school authorities should take steps for ascertaining the real working capacity of the flues in the school-houses, for the degree of deficiency can never be known in any other way. The anemometer will give a pretty faithful statement of the current actually passing the flues. Analysis for carbonic acid in the air of the room will give an excellent test. Nor ought we to pass without mention the useful but too often uneducated sense of smell; it furnishes data which make the foundation of all our mathematical calculations, and is by itself a faithful guide for a short time.

A ventilating flue must draw, or it is worthless. This quality, which forms its sole merit, is aided by several other points.

1. It should be as straight as possible from beginning to end. Curves and angles are very great obstructions.

2. It should not, as a rule, be horizontal, or descending in any part. There are special exceptions to be noted hereafter.

3. It should be continuous from the beginning to where it discharges out of doors. A flue that ends in an attic has less carrying force than one that goes up through the roof. The air comes up with a rush, and is dispersed in the air of the attic; the rush, the momentum, which it brings with it is lost in the space. True, the air will get out by an Emerson ventilator at the ridge-pole, if there is one, but the conditions for successful working are best attained by a continuous column.

A tight box lined with tin may properly be used to collect the flues and discharge their collective contents by an opening, as in Fig. 1.

4. It should be smooth internally. A tin pipe is as good as any, and has the advantage of not parting with heat so quickly as dark or slightly roughened metals will. If a brick flue is used it should be larger than the dimensions named above, and should be plastered smooth inside. The hollow spaces in walls should not be relied on to do the work of flues. The width is very small, and the friction against the bricks or lathing is enormous.

5. It should be so protected as to lose no heat. A tin flue passing through a cold entry should be boxed with wood. It should not have a very great distance to traverse in the open air, if of metal. There is, therefore, a certain advantage in compelling tubes to converge inside of the attic, as in Fig. 1, instead of passing up straight through the roof, as in Fig. 2.

6. It should be so protected that the rain will not beat in or the wind blow down. Certain caps will accomplish this object satisfactorily.

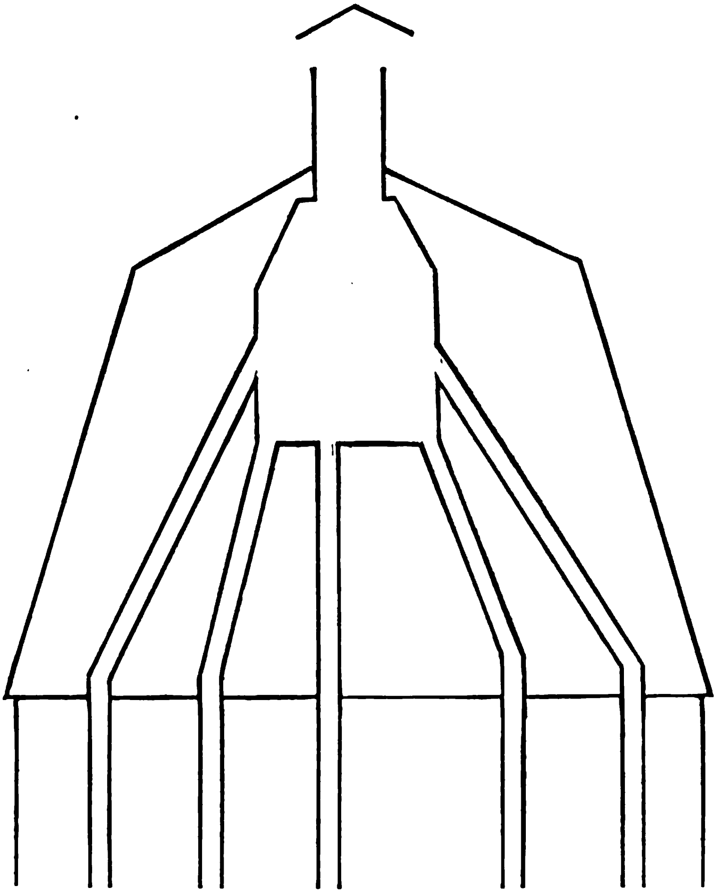


FIG. 1.

There are other caps which increase the upward draught when the wind is blowing upon them, but their action is uncertain, and they may sometimes check the upward current instead of assisting it. The

outlet should not be a narrow one, barely equalling the capacity of the flue, and compelling the current to twist and turn in making its exit.

7. The flue must be devoted to the uses of a single room. If it opens to rooms on successive stories it often serves as a passage from one story to the next above, especially when the flue is not warmed. The heated flue, on the other hand, when drawing from different stories at once, has a much less powerful action upon the upper story.

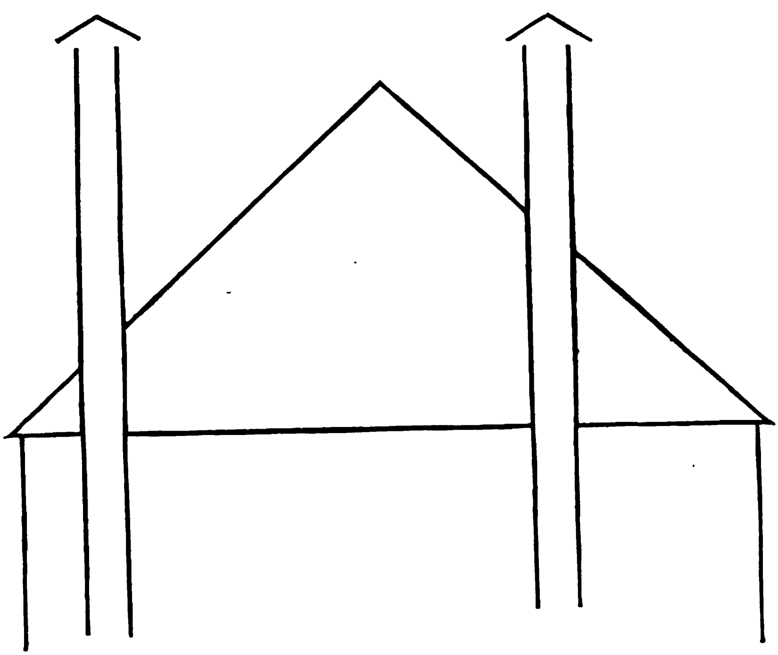


FIG. 2.

8. The flue should be warm; at least it must be as warm or warmer than the outer air, or else the current will be inverted.

Flues ought not to be placed in *outer* walls. Much heat is lost and the opportunity for heating by contact with the chimney is sometimes omitted. An air-space is sometimes employed as a defense. When, for instance, the triangular brick flue is placed in the corner of a room (which is a good arrangement for saving space), the wall should be double on the outside.

The subject of applying warmth to flues is a somewhat extensive one, but a few methods ought to be mentioned.

(*a*) A brick triple-shaft with the central part devoted to the smoke from the furnace and the two side-flues for ventilators.

(*b*) A brick-flue heated by a metal-flue (twelve-inch cast iron pipe) divided into sections.

(*c*) Flues of any kind containing steam pipes or coils.

(*d*) Steam-coils placed in the chest at ridge-pole (fig. 1). This is not an economical way to apply heat; it affects only the upper few feet of the column of air.

(*e*) Gas-jets burning behind a pane of glass, which is let into a tin pipe. This is very efficient, yet inexpensive in construction. The efficiency is increased by Gouge's methods.

(*f*) In a variety of ways the stove or stove pipe can be made useful to expel air from the room.

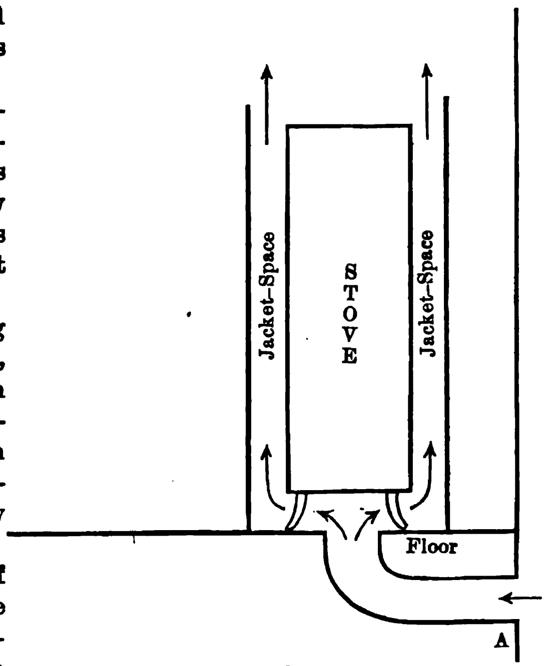


FIG. 3.

The "jacket" or metal screen is a thing of which no stove in an inhabited room should be destitute as a protection from heat. But it is mentioned here as affording an aid to ventilation. Figure 3 shows how this is done. A metal cylinder, considerably wider than the stove, is placed around the latter, and its edge is fastened to the floor. A good sized pipe is then carried through the floor, under the stove, and led through the house-wall at A. Guard the inlet with a screen of wire at A, and a large supply of pure warmed air is drawn into the room. This is one of the cheapest and best devices for warming and ventilating. Some prefer to extend the jacket around only a part of the stove and leave the door uncovered; or the jacket may stop at the bottom of the stove and be made fast to the latter at that point. The arrangement is equivalent to a "portable furnace," such as is usually placed in a cellar or a basement hall.

In *figure* 4 a stove is represented standing close to an open window. The movable semicylinder of metal, commonly used for a screen, has been so placed as to enclose the stove on all sides except that towards the windows. Cold air may then be freely admitted; it is quickly

warmed by contact with the stove and is thrown upward with the general current.

Figure 5 shows air brought in so as to be warmed by contact with a stove pipe. The inlet flue is enlarged and runs up with the stove pipe, like a jacket, for same distance.

Figure 6 shows how a stove pipe may assist in removing injurious air. The diagram represents a two-story house with a chimney which comes down to only a very short distance from the roof. The opening into the chimney for the stove pipe is enlarged so as to receive a much larger pipe, which encircles the stove pipe like a jacket. This jacket may stop short at A, or may be carried through the floor to B in the first story. It will secure a draught from either story as may be arranged. The idea of this and the preceding figure is borrowed from an article in the report of the Michigan Board of Health for 1879.

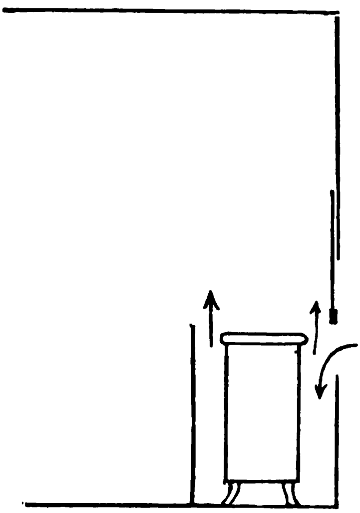


FIG. 4.

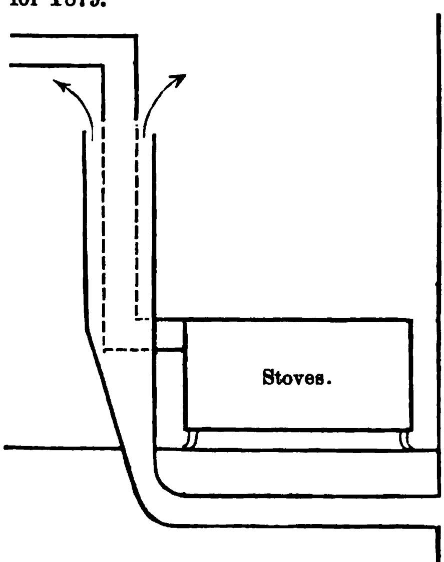


FIG. 5.

A chimney into which a smoke-flue discharges may be opened at any point *below,* and not too near, the point where the smoke enters. Many rooms, for instance, have chimneys which reach to the floor, while the stove pipe enters near the ceiling; such chimneys ought to lend their powers to the task of ventilating the room by an opening near the floor. The latter ought to be closed when the fire is making.

The term "aspiration" is applied to the suctional force of heated flues. The method by aspiration has been used systematically in large school-houses making one shaft do the work for the whole house; in which case

the room-flues are often made in the floor, running across to the brick shaft. In some cases all the flues are made to descend to the base of the shaft before entering it. A discussion of this matter on a large scale is beyond the purpose of this paper Where the number of rooms is great, and the exposure to the weather is different in different parts of the building, unequal action is likely to occur.

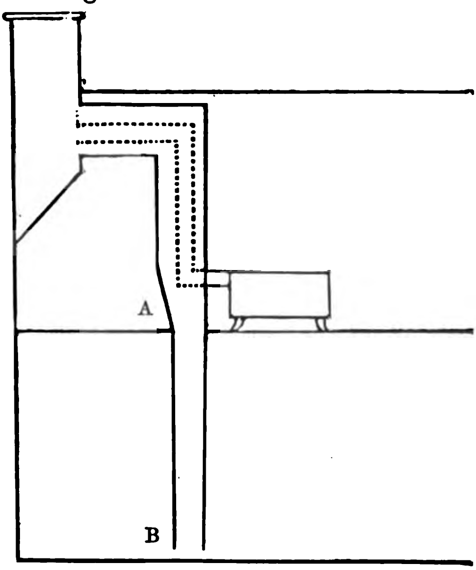


FIG. 6.

If the shaft or flue opens into the upper part of a school room, the air drawn out is several degrees hotter than if it opens near the floor. The draught is therefore more powerful. Still, it is best to carry the shaft nearly to the floor, where its effect is to stimulate the circulation of the warmed air in a downward direction, and to increase the heating power of the stove. No draught will usually be felt from it by a person sitting a the distance of four or five feet. We need not be influenced by any theoretical considerations as to the level where carbonic acid is most abundant—there is no great and constant difference between different levels; but we shall not fail to find sources of impurity of air more frequent at or near the floor than higher up. If gas is burning, the case is different.

As regards a heating apparatus, furnaces in cellars are most manageable when standing directly under the rooms they are to heat, or at the windward corner of the house; in other cases they sometimes play strange tricks, refusing to yield warm air, or drawing it out from the room. A steam apparatus has this advantage, that the heat can be placed just where it is needed. Whenever a supply is wanted in a room, a tin pipe (wood should be avoided as unsafe), can be led down from that point to the cellar, and a steam coil put there, encased in a wooden box lined with tin to save heat, which has a value for stormy weather; but in no case should air be taken from cellars for school consumption—certainly not while the school is in session.

There is much carelessness about the source of air which is drawn into furnaces for heating, and sent up into rooms. The ground may,

it is true, be a pure and inoffensive bit of turf, but that is an unusual condition in the school yard. Bad air, malarial air, is known to settle upon the ground in many cases. The ground-level is less reached by the renovating breezes than higher levels. Sundry unpleasant elements in the surroundings of school-houses are at the ground-level. As a rule, openings for drawing the outer air into the house had better be at points above the children's heads, and covered with wire netting.

Something more should be said of the cellar. It cannot be too often repeated, that the purity of cellar air lies at the foundation of the purity of house air. The danger of severe and sudden illness lurks in cellars, as often as in sewers. The common practice in regard to cellars is to bury the drain under its floor — to place water-closets in its darkest corners — to store combustible rubbish in wooden bins (I have seen great heaps of paper scraps)— to pile away old rotten boards and clothes — to hang children's outer garments in it,— in short, there are few uses of a menial sort to which it is not put. The cellar is often without a proper floor, often is very dark and close for want of windows, often is darkened by placing the heater-boxes in front of windows.

To these sources of pollution (for darkness is one source) add the fact that in cold weather a powerful outside pressure exists, forcing air into the cellar, and thence into upper parts of the house. It is too much to expect that an average cellar will be so pure, so free from all these objectionable things, that air may safely be taken up from it by furnaces for the consumption of the house.

Let the floor be concreted or asphalted so as to be air and water-tight. Put no drain underneath, unless in a trench with a wooden or stone cover. Put *one* large trap outside of the walls for each sewer, ventilate it by an opening just inside the trap; run the soil-pipe up full-size several feet above the roof, and protect it from rain; ventilate the trap under each washstand. Have no water-closets in the cellar; or it they be thought necessary, isolate them in separate chambers of masonry with abundance of light, accessible to the children from the outside only of the house. Give a plenty of windows, and good height, and keep the walls whitewashed.

Some are in favor of "direct radiation," *i. e.*, of heating by coils placed in the school-rooms. It is economical of heat, certainly, for a great deal is wasted in the cellar by the arrangements which are now common; but this waste cannot be necessary. The objection to "direct" heating is the deficiency in the supply of fresh air. The same objection holds good in the case of "hot-air furnaces," if they are driven excessively, and deliver a small quantity of over-heated air. The latter condition should be rectified by making the furnace and its channels

of inlet and delivery *large enough* to give an abundant volume of *warm*, not *hot*, air. There is not much to choose between a red-hot furnace and a steam-coil. The coil can, however, be treated as a stove is treated in figure 3, and all objections to its use will disappear.

It must be constantly borne in mind, that the scholars are not to be exposed to draughts of cold air when it is possible to avoid them. In every way, we should try to warm the air, even a little, before it enters. The methods given in figures 3 and 4, should be considered as the best substitute for perfect ventilation, but as distinctly inadequate to supply the air required, unless supplemented by those which warm the air before entering.

In a room heated by direct radiation, and provided with a strong exit-draught, the air seeks to force an entrance on all sides. If it enters by opened windows it causes draughts. If the windows are closed, a portion must come from entries, halls, cloak-rooms, closets, cellars. In fact, all the lower parts of the house are naturally drawn upon, when windows are closed.

A point against the direct method of radiation is the difficulty of governing the amount of heat in mild weather. This should be considered, however, as a defect of arrangement. Coils should be in duplex or triplex systems, and it should be easy to shut off steam from one-half or two-thirds of the pipes.

No system of flues, however skillfully and liberally planned, is likely to take the place of windows altogether. This paper has already made the assumption that school-houses require but half the amount of fresh air which is required for permanently occupied houses. What justifies the assumption? and what conditions must be looked to in order to supplement the assumed deficiency? "Thirty cubic feet of fresh air per minute and head" will not keep a closed room fresh for two or three hours of uninterrupted school-work. Four other things must be alluded to:

1. Frequent airing-out of the rooms.
2. Systematic opening of windows.
3. The original floor plan.
4. Cleanliness.

1. Troops on the march are accustomed to halt ten minutes at the end of each hour. A school should also have its halting times (and once in an hour is not too often), when the air may be renewed by a quick and brief opening of the windows, while the pupils go through some light gymnastics. A principal use of the fifteen minutes' recess is to effect this more thoroughly. A complete renewal should be accomplished after each session, and no room allowed to be closed after sweeping until the dust has wholly subsided as far as the sense of smell can judge.

It is no wonder that teachers are glad to get rid of the old-fashioned school recess. Houses are now placed in the midst of thickly-settled towns, where the children, if they are allowed to run in the streets, are in personal danger, and if kept in the yards, have hardly elbow-room. Their shouts annoy the neighbors — though shouting is really one of the best parts of their play. Some teacher has to watch them while in the yard; and this must be, especially for ladies, one of the most difficult and distasteful parts of the teacher's duty. If the rooms are aired out at recess, some of the delicate or lazy, or over-studious, will object to the draught. I know a school where there is but one yard for boys and girls; they have, therefore, a recess at different times for the two sexes, and one-half of the scholars are always left in the rooms, so that no airing-out is possible. Still, the uses of recess remain. To provide for the delicate children, or for the case of bad weather, a play room, warm, airy and light, ought to be provided.

2. No apparatus that can be named will do so much good at a very small cost as the window-board. By that term I mean a plain piece of board, as long as the window is wide, and from four to eight inches wide. The lower sash is raised, the wood is inserted, and the sash is shut down upon it. The air enters in a thin stratum passing upwards between the upper and the lower sash, in a nearly perpendicular direction, without causing perceptible draught.

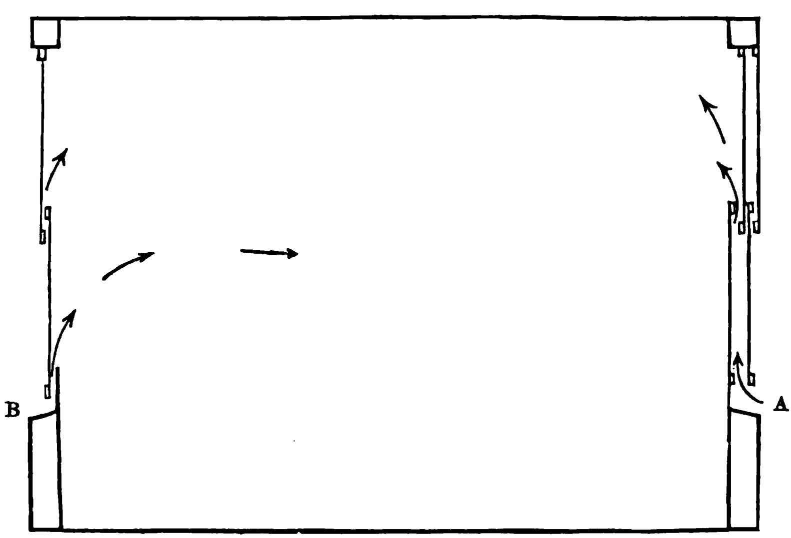


FIG. 7.

The diagram (fig. 7) represents a window provided with the board, and air entering at A. The window is, however, represented as

double; this gives great protection from the cold, and also enables the air to enter the room slightly warmed by contact with the lower pane. All four sashes of double windows should be movable.

At B there is a different arrangement, for mild autumn or spring weather. The board is made wider, and is placed an inch or two from the sash, in such a way as to direct a current upwards. If tilted (fig. 8) the cold current strikes the bodies of the scholars.

Opening at the top is not so safe as this method in cold weather.

The direction of the currents (shown by arrows) cannot be uniform, but must be ascertained by the teacher, who should occasionally occupy a seat at different distances, to note the effect.

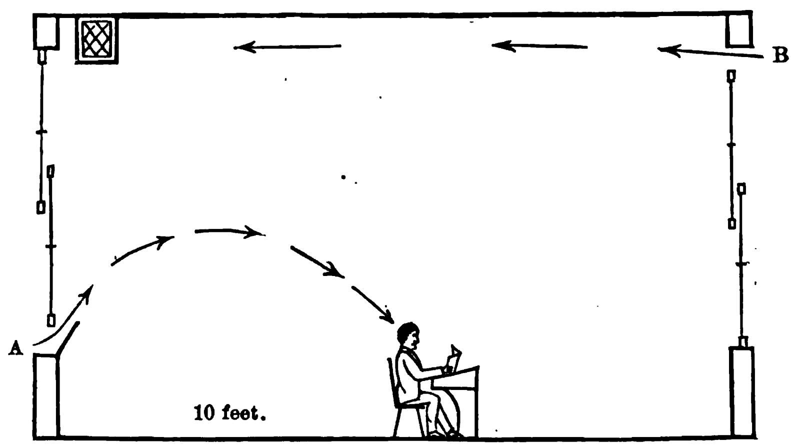


FIG. 8.

Figure 8, B illustrates a tendency which air currents possess to cling to surfaces which they have come in contact with. The top of the window is close to the ceiling, and a strong current passes straight to the ventilator, doing no good in its passage, and retained in its elevated course by momentum and cohesion against gravitation. The air from the top of a window usually falls, of course.

The window-board is sometimes pierced with holes for the tin pipes which are bent upward at right angles. This effects the above-named results at a greater cost.

A kind of mosquito-bar, covered with thin flannel, may be used to sift dust from the air. But dust-sifters are air-stoppers. Such apparatus is not adapted to the case of rooms with many occupants.

3. In planning a house, it is well to place the windows and doors so that those slight currents which enter by cracks or by partial openings may traverse all parts of the room. We thus call to our aid a correct principle of "natural" ventilation which should not be lost from sight

even when we think our artificial methods are perfect. Let each room be adapted to the rapid renewal of its air by swift currents which reach every corner as soon as windows and doors are flung open; and let this kind of airing occur more than once in each day's work, and once after each day. Such a room is seen in Fig. 9. A room planned as in Fig. 10 will be likely to have less perfect ventilation. And Fig. 11 shows a still more decided error. (Compare rooms E and F in Fig. 13, which are well ventilated.)

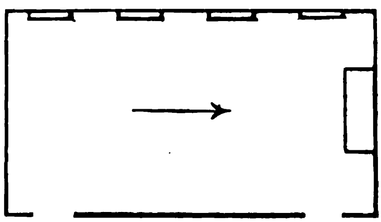


FIG. 9. A room well shaped for imperceptible ventilation, or for quick change of air when desired. Two doors four windows. Pupils face direction of arrow.

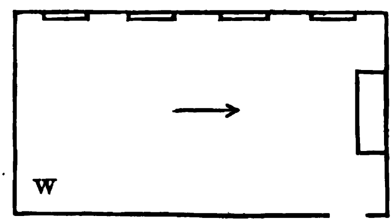


FIG. 10. Ventilation more liable to be imperfect. One stagnant corner at W.

A corridor or hall may be regarded as a supplementary aid to ventilation. It ought to have sufficient means of heating, and here, if anywhere, is the place where direct radiation is suitable. It should run straight through the house and have practicable windows at both ends which should be open except in the severest weather. Not being occupied by scholars the air will be easily kept pure under these circumstances. The use of transoms over doors is to draw upon this supply of pure air.

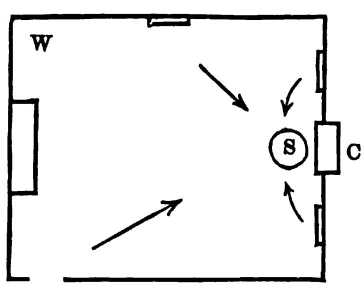


FIG. 11. The chimney, C, draws air from the room by two ventilating holes. The stove acts in like manner. Air entering by small cracks at a door and three windows, taking the direction shown by arrows, leaves the corner W, unventilated. Taken from a school in Rochester.

The school-house should be so cut up by corridors that every room should have a corridor running along at least one side. A house thus cut up is analogous to a city with broad streets; the air circulates more quickly and in larger masses.

The heaping or packing together of rooms is a distinct impediment to ventilation. The air which passes into a room through unperceived channels may be estimated as sufficient to change the contents of the room once in an hour. Now, every room has four sides, a top and bottom. Examine the condition of a room thus packed — say one of

the middle rooms in Fig. 12. It has a cellar below, rooms on three sides and above; hence its unperceived renovation of air must come very largely from impure sources. Wind blowing from A will force air into B; wind blowing from C will force the air of the front room through the middle and rear rooms. The very multiplication of partitions, however, is itself a check to currents of air.

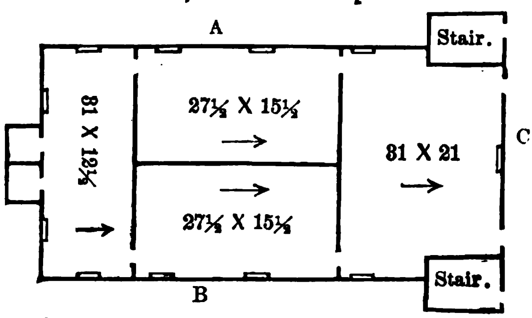


FIG. 12. Seventh Ward School, Troy. Unsurpassed for compactness; glass partitions; pupils face the light.

Figure 13 shows a good use of corridors. Better still, if rooms A, B, C, D, had been placed lengthwise along the corridor.

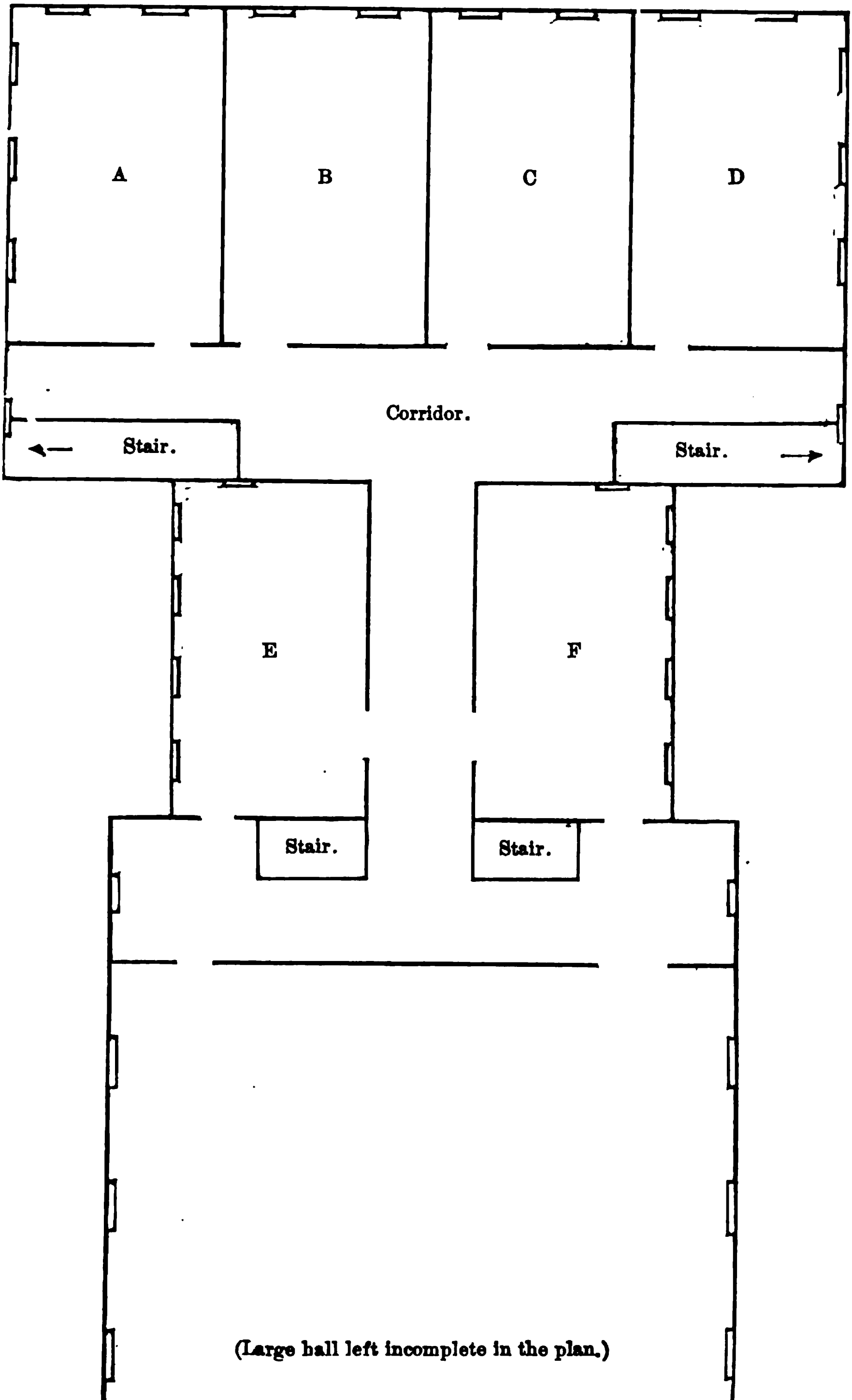


FIG. 13. School No. 2, Yonkers.

The analysis of plans of school-houses leads us to form a distinct class or group of those which have recitation rooms as an adjunct to one large common study room. This, the recitation room plan, as it may be called, is exemplified in Fig. 14. It has the faults of the compact plan, with very little modification. In a house of this sort one looks into the small rooms at once for instances of bad air and crowding. It is not sufficiently remembered by school builders that the class requires pure air when reciting as well as at other times. One half of the scholars are sent in to the small rooms, which in aggregate space may equal one-third of the room they leave. Those left behind enjoy tolerable air; while commonly those reciting are intolerably confined and cooped up, without a chance for relief (for draughts at close quarters are dangerous) until the hour is over. The example following (Fig. 15) shows an improvement in two respects, as indicated in the note to the cut; it is evidently based on the previous model, while the two following show a like affinity for each other (Figs. 16, 17). The objections on the ground of light will be named on a later page.

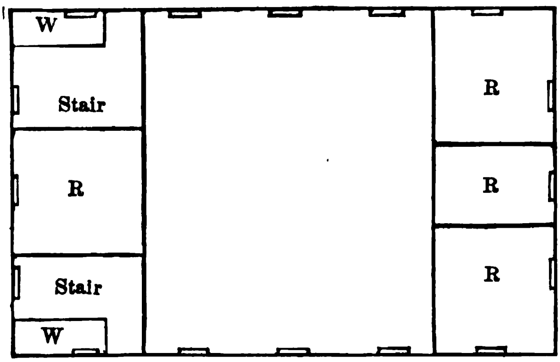


FIG. 14. Thirteenth Street School, Troy, old pattern; recitation room system.

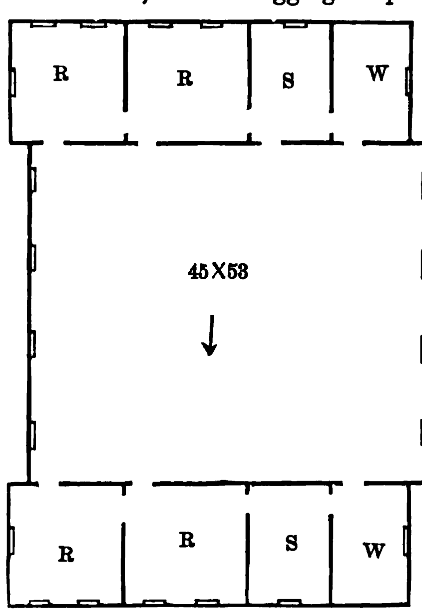


FIG. 15. Sixth Ward School, Troy, built four years ago. (R, recitation rooms, about 16 feet square; S, stairs; W, wardrobes.) This figure shows the recitation room system; size of R still too small for the number that occupy them; breadth of large room between windows more than is desirable. The improvement, as compared with Fig 14, consists in the placing of the stairs at both ends.

Poor ventilation is so often connected with over heating that the latter must be ranked with it as a cause of ill-health. Hot rooms are a common cause of "taking cold." They give a headache to some. They sometimes aid in keeping up a forced ac-

tivity of the circulation of the brain and nervous centers, causing nervous irritability and sleeplessness. Weak sight, especially near-sight, is greatly aided in its development by hot rooms and bad air. The heat acts at once in flushing the face and producing congestion of the eyes. It acts indirectly and chronically by producing a slow debilitation of the system and impoverishment of the blood. Such a condition is most favorable to the production of weak or short-sight. Bad air, poor food, late hours, overwork, dissipation, anxiety, are causes which work toward the same result.

What is "over-heating?" It is a little difficult to reply. However, it is certain that there are teachers who succeed in keeping themselves and their classes comfortable and cheerful at temperatures ranging from 60° to 65° Fahr. I have seen a boy of ten years sitting in shirt sleeves, having taken his jacket off because he was too warm; the thermometer stood at 62° on the desk beside him, and the other pupils were comfortable also. It is clear to me that the range from "68° to 74°" is decidedly too high for a standard. Some teachers may require this degree of warmth, especially if suffering from colds; but a lower range, even one which has 68° or 70° for its highest point, seems desirable for schools.

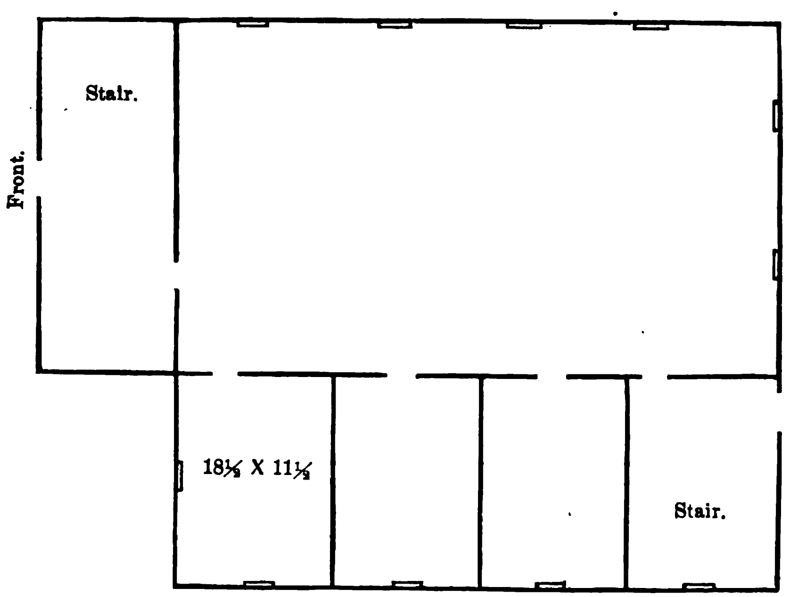


FIG. 16. Court Street School, Utica. Compact arrangement, four rooms contiguous. Could easily be enlarged so as to give four rooms, forty scholars to each room, with corridor in middle. Arrangement bad for airing small rooms.

4. There is an invisible something which clings to the substance of wood and plaster, and continues to give out a smell after the air has

been renewed. This sort of emanation cannot be conducive to health. It brings startling suggestions of "hospitalism," or hospital smells and infections. Whoever will aid in banishing this smell from schools is a benefactor. Strict cleanliness is the remedy, associated with good ventilation.

It is not superfluous to say that once or twice a year is not often enough to wash the school-room floors! Schools do exist in which the washing is done weekly on Saturday morning, the sweeping daily after sessions, and dusting daily, in the morning everything being finished half an hour before school opens.

A floor ought to be non-absorbent. Seasoned yellow pine and maple are both good materials; they can (especially maple) be so prepared by oiling as not to need washing, but only the use of a damp cloth.

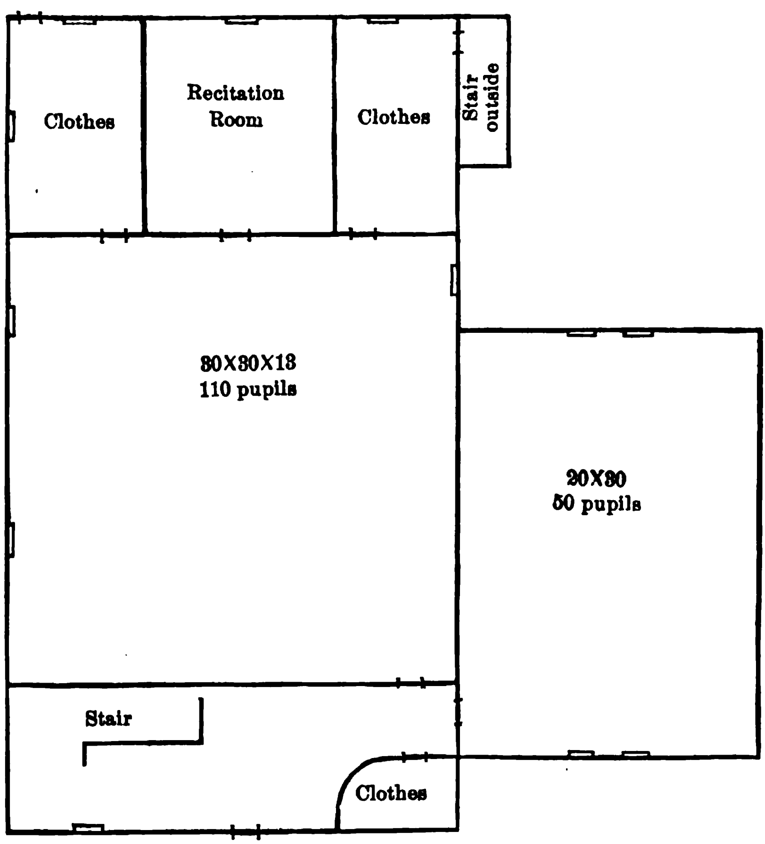


FIG. 17. Francis Street School, Utica. Light insufficient in large room. Compact arrangement interferes with lighting and airing. Very badly planned for natural ventilation.

Dust comes from the mud brought in upon the children's shoes. There ought to be no muddy school yards. The use of mats and scrapers must be provided for and enforced.

Children of the poorer classes come to school with their clothes smelling of the day's cooking, and much else. Teachers and charitable visitors can do much to encourage or compel children to come with clean and decent garments, and clean face, hands and hair.

It is not proper to hang overclothes in the rooms where scholars sit. A closed wardrobe or closet in the school-room condenses the effluvia, and concentrates the effect of packing a quantity of moist, reeking rags. The chance of diffusing infection is increased by such contact. A closet should be large enough for each child's clothes to hang without overlapping another's. It should have good light, and free circulation of air, and be well warmed. If the corridors are wide, warmed, airy and light, a portion may be set off by a board partition for the use of each class, the boards to reach six feet in height, and to come within six inches of the floor. If clothes are hung in the basement, care should be taken that the furnace does not send the air of the clothes-room up-stairs.

Walls that can be washed are a desideratum; paint answers the purpose well. Wall-paper is so pretty that it is a pity to condemn it; but it is very absorbent, and not allowable under strict sanitary rules where large numbers are congregated.

Lighting, and Eye-sight.

The influence of school-life in promoting the increase of near-sight, is by this time one of those commonplaces of which the reader cannot be supposed to be ignorant. Germany, Russia, Switzerland and France have all contributed statistics, showing that the affection is a universal epidemic, localized wherever severe study is pursued, attacking all grades except the very youngest, and increasing in regular progression from the commencement to the end of study. At the moment of writing, a paragraph is going the rounds of the newspapers, giving the statistics of the six hundred pupils in the High School of Chemnitz, Saxony, in which, in eight classes, beginning with the lowest, the proportion of near-sighted is respectively 10, 17, 20, 25, 35, 44, 44, 64 in 100. This one series is a fair representative of a score, all made with great care and exhibiting the same result.

The case is different in America — but only in degree. Children study a good deal less, their school accommodations (in cities, at least) are better, and their mode of life in some respects is better, than in Germany. But there is a considerable amount of near-sight in this country. Three hundred and twenty-one students were examined by

Dr. Derby on entering Amherst College, and 35.9 per cent were found short-sighted. One class entered with 44 per cent and graduated with 50 per cent. In brief, although we have less absolute near-sight, still, that which we have, is of the same nature and tendency; it is engendered by study, and is increased by continued study as rapidly as in Germany.

The percentages of near-sight in 2,500 public school children, examined by Drs. E. C. Loring and R. H. Derby, in New York city, were 3.5 for the youngest classes and 26.78 for the oldest. The poverty of blood and weakness of fibre which are produced by bad ventilation and over-heating contribute to the causes of near-sight in no inconsiderable degree. The point of most immediate interest, however, is the amount and distribution of light in school-rooms.

Certain fashions in architecture interfere with the requirements of airing and lighting. Pointed windows, heavy mullions, buttresses and cornices, may do so. In all styles, except that based on practical usefulness, the size of and position of windows are subordinated to architectural effect. Small sized windows are employed to produce an effect in the façade, in that domestic classic style which was so much in vogue in the early part of this century, and which has left traces upon our school architecture. A frieze, in a classically proportioned house, occupies a band of several feet in width below the eaves, which must be kept sacred from such vulgar uses as that of windows. The frieze may not be actually there, but a place is left for it, a blank ribbon of wood or stone above the brick wall and the window-heads. Classic usage requires a strict subordination of windows; one might almost say, a suppression.

In certain places there prevails the singular custom of making the upper story much higher than the lower. For example, in Rochester School No. 19, the distance from the top of the glass to the ceiling is 28 inches in the first story and 78 inches in the second. The High school at Binghamton has four stories, the height of which, beginning at the bottom, is respectively 14, 15, 16, 17 feet. This practice is related to the custom of using the upper story for a large hall or assembly, but it has been retained (from habit?) in cases where there is no such hall. It has the advantage of airiness, but the architects have not seized the full advantage of the arrangement by carrying the windows up near the ceiling. A certain loss of light results, which is seriously felt in certain cases, as in that of the High school at Rome in Oneida county (a classic structure).

Glass sliding-doors are still in frequent use in some places, but I am inclined to think that they are going out of fashion. It is doubtless supposed that they give aid in lighting the rooms; but this is very questionable.

During the investigations referred to in the report of the Committee upon Public Institutions, there has been frequent opportunity of comparing houses built upon similar plans, but differing in this one respect; and it has not seemed that those with glass were better lighted than the others with solid partitions.

From a theoretical point of view, we must consider:

1. That the glass in the partition reflects a part of the light and throws it back out of the window.

2. That it absorbs a part.

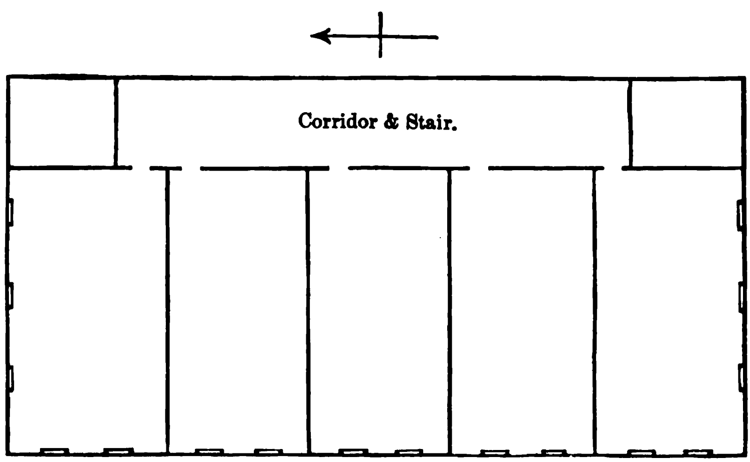


FIG. 18. School No. 13, Rochester, Second floor. Division into five equal rooms by glass partitions. Very poor light and diminished ventilation in three interior rooms.

3. That it allows a part to pass straight through and out by the windows of the opposite side of the room or house. To this add the fact, that in examining the plans of houses where glass partitions are used, we find that there is not generally light enough to supply each separate room, supposing the partitions to be solid walls; from which we are entitled to infer that the planners thought that the supply was increased by using glazed partitions. Figure 18 will illustrate this. No one could suppose that the architect intended to illuminate those long slips of rooms by two moderate-sized windows at one end; but in reality the light does come almost wholly from that quarter in all the inner rooms.

Figure 19 shows a more recent plan, which looks attractive. The middle room of three receives light from the rear and two sides. Why does it not receive enough? The answer is a two-fold one: First, because so much side-light is cut off, and second, because the side-light is so distant and slanting.

1. To a person standing in A (see fig. 21) the objects in B seem less distinct than those in A. A part of the light is thrown back from the glass into A, as we may see by the reflections on the sash. The ceiling and floor of B are darkened by the wooden frame-work, and the grooved beams in which the door-heads slide. A person at B notices an increase in the light when the sash is opened.

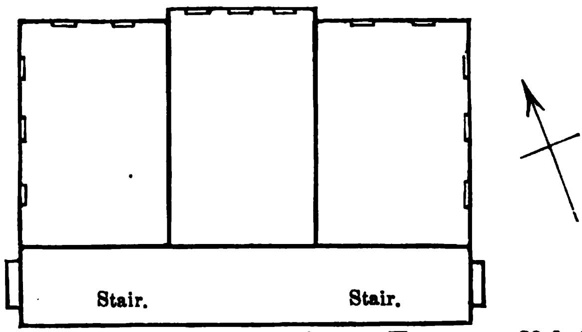


FIG. 19. School No 24. Rochester. Three rooms 32 feet long, with sliding glass partitions.

2. A side-light from the window at A cannot be expected to be of much use beyond the width of A. It strikes B too obliquely. The simple rule of allowance for depth is, that no window shall be required to throw light to a horizontal distance greater than once and a half its height, supposing its head to be quite near the ceiling. The diagram represents a row of rooms, each twenty-four feet wide and fourteen feet high. The window head is three feet from the ceiling, and eleven feet from the floor (as is very often the case); the light

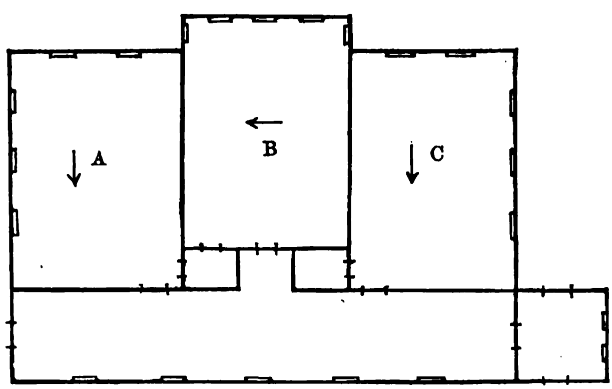


FIG. 20. School No. 26, Rochester; built 1879; first floor. Here there is an evident attempt to remedy a defect in such a plan as that of Fig. 19. The middle room is of the same size as the others, but has five windows all at one end; a great gain as compared with No. 19. The inferiority of B to A and C is still evident, however.

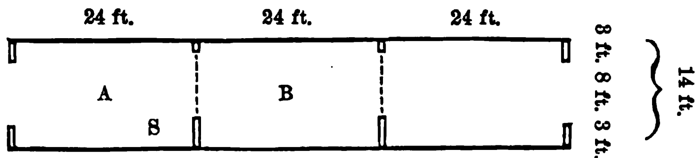


FIG. 21. Diagram of section three, rooms from side to side, with windows in the outer rooms and glass sliding doors between. (From Fig. 19.)

may be sufficient as far as the mark S on the floor. If the house stands on a large lot with a wide, open outlook, the inner seats, in A, will be well lighted ; but in an average street, with houses of moderate size opposite, they will be poorly lighted. A portion of the light in B will be very poor, indeed. Finally, the light that goes through from A to B is chiefly lost to A ; if a smooth white wall were put instead of the glass sliders, the

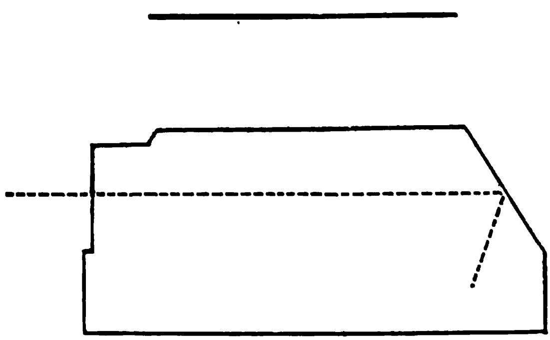


FIG. 22. Cross section of room with sloped inner wall, with a ray of light reflected from wall.

wall would throw the light back upon the desks in A. This part of the light is really needed, and it is most needed just where it comes, at the back of the room. A good deal is gained by slanting the inner wall (where that is feasible) so as to throw the light more directly downwards, as in figure 22. The writer has knowledge of one room in the Albany High School which is a favorite with the pupils for this reason. But even an upright wall is of much value as a light-giving surface. The ceiling is of great importance in this respect, and must not be cut up by cross-beams ; it should be white, while the walls are tinted very slightly in some neutral color.

If these three rooms were thrown into one, the product would be a room of the width of that in the Syracuse High School (fig. 23), which is seventy-four feet across and fourteen feet high (this is not a solitary case either), with windows two feet from the ceiling and two and a half feet from the floor. A ray of light is seen analyzed into three parts, A=$\frac{10}{12}$ths, falling on the desks in the left hand half ; B=one-twelfth on the desks in the right hand half ; C=one-twelfth going out of

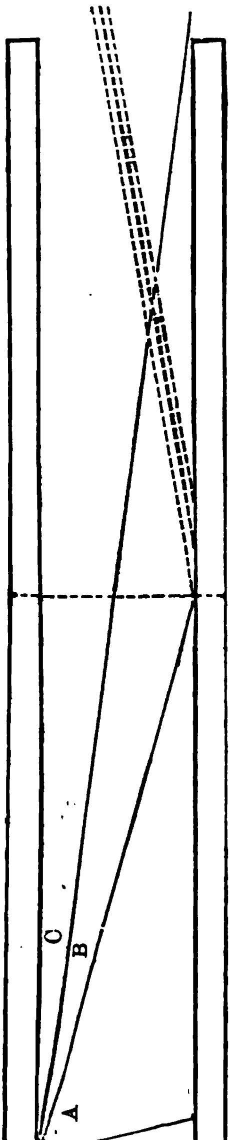


FIG. 23.

the opposite window (the dotted upright line represents the imaginary middle line of the room).

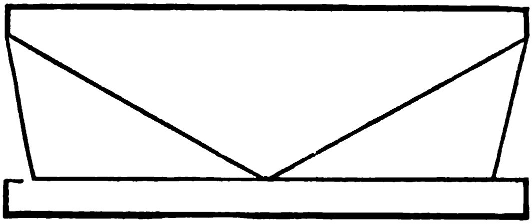


FIG. 24.

Figure twenty-four is a room half as wide as figure 23, introduced to show that the light falls twice as directly upon the desks.

Fig. 25 represents the angle at which light from the *center* of a window strikes a desk in the middle of a room like that of the Syracuse school. Let the reader note also, that

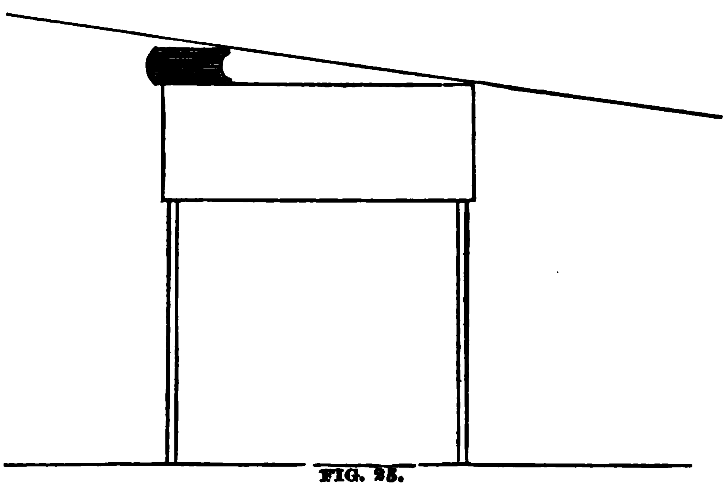


FIG. 25.

this is the angle at which the light strikes the inside desks of a room thirty-five feet wide, lighted from one side, and he will be ready to admit that this depth is properly condemned as altogether too great a for successful lighting by ordinary methods.

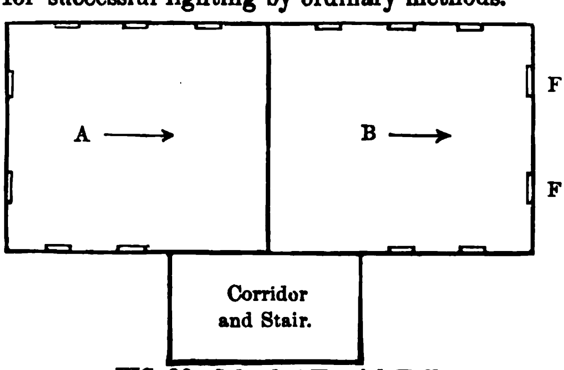


FIG. 26. School at Hoosick Fall

The most valuable light is that coming from the center and upper part of the room or window. The more perpendicularly it strikes, the better. Therefore, the window-heads ought to be as near the ceiling as possible; that is within six inches or thereabouts.

A few more illustrations of imperfect lighting may profitably be added Fig. 26 represents a school at Hoosick Falls. The two rooms, which constitute one floor, are each thirty-five by thirty feet in size. A sliding glass partition throws both into one, for the purposes of exercise in common. This presupposes that the scholars face the same way in both rooms. The windows at F F are necessarily closed, and the light in B becomes insufficient, the combined area of the glass equalling one-fourteenth of the floor space. Other instances of facing the light for a similar reason are shown in figs. 27, 31–34, and others, where, as usual, the arrows show the direction of the facing.

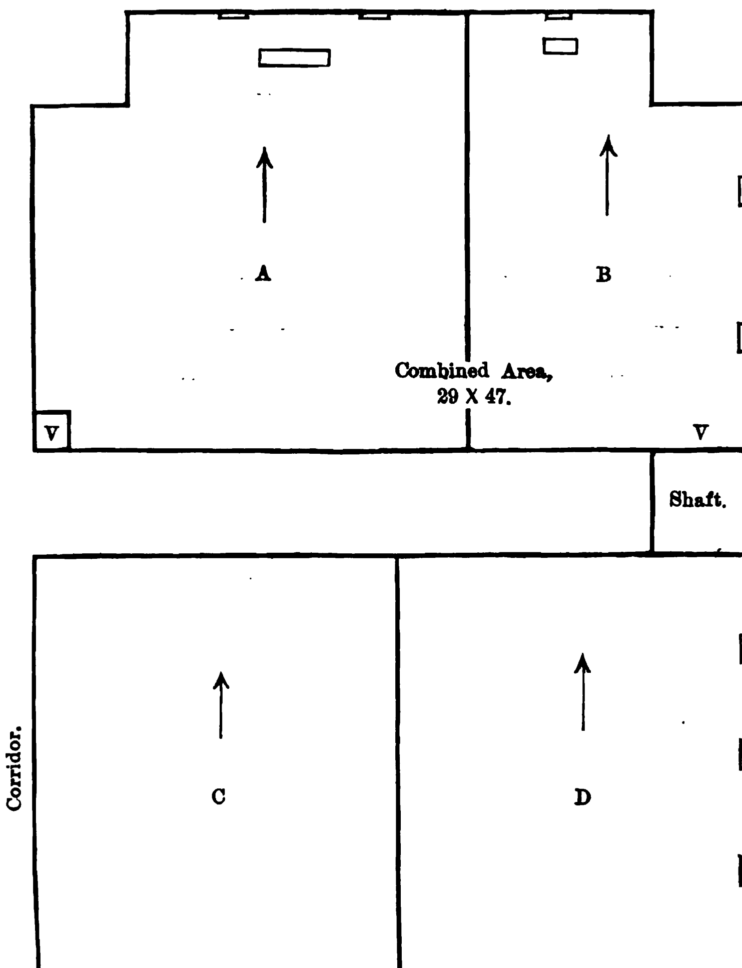


FIG. 27. School No. 10, Rochester, third floor.

Fig 27, represents four rooms in the upper story of school No. 10, Rochester. The corridor occupies the left hand, but is not given in the drawing. The four rooms are entered by an alley between glass sash-work. The partitions between A and B, C and D, are of glass. A and C are poorly lighted; A especially so, since all the light, with the exception of a little from the windows in B, comes from directly in front. There are, of course, windows in the outer corridor wall; they may be said to be thrown away for the purpose of lighting the rooms, and the same criticism applies to figures 18, 19, 20.

The arrangement is an extremely bad one. Even the shaft (for ventilation) is so situated as to take the place of one window, and the towers (indicated by indentations at the corners) take the place of at least one window.

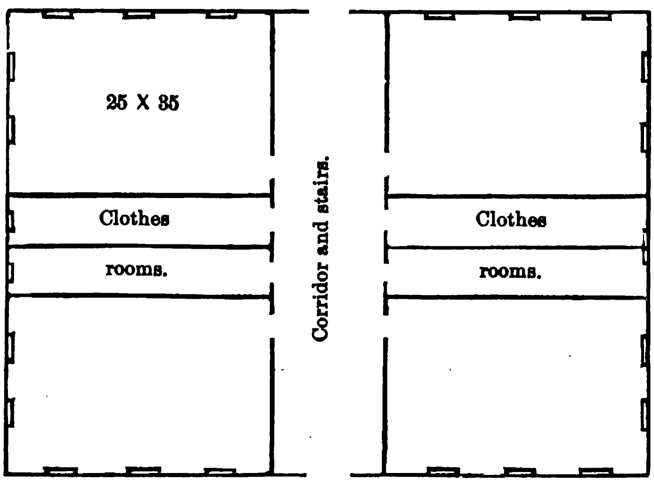


FIG. 28. Type of a school house with none but corner rooms.

It is easy to see how this plan might have been changed. The house is nearly square, and the dimensions would easily admit of four oblong rooms on a floor, with the entry or hall running straight through between. Upon this plan are built schools No. 15, Rochester, and 21, Albany, both at present fairly well ventilated, owing in large measure to the arrangement which gives thorough ventilation of the halls, assigns to each room two exposed surfaces, and does not allow any two class-rooms to come in contact. The scheme is illustrated in Fig. 28.

The difficulty in the case of corner rooms is, that either the scholars or the teacher must face the light. To many teachers this is a serious evil. Injury may easily be inflicted on the eye-sight. If the teacher is much employed in work with the blackboard, and the maps, and reading-charts, and is more on her feet than in the chair, the difficulty

may be overlooked. But if obliged to sit while conducting lessons or overseeing study, she should be protected by a screen. Such a screen is in actual use, and is much prized in all the rooms of the Albany High School. There are two patterns, one wholly of wood, the other a wooden frame covered with cloth and sliding on an iron bar with a heavy foot. (Figs. 29, 30.) They are placed on the desk in front of teacher. The ideal schoolroom is one with only one exposed side, whereby the most uniform illumination is secured. (Fig. 9.)

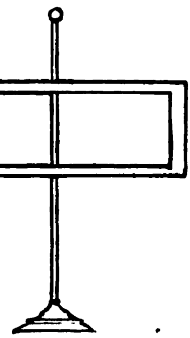


FIG. 29.

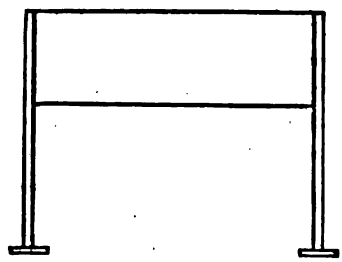


FIG. 30.

Country schools are apt to be incorrectly lighted. But few are so badly off as this octagon (fig. 31), where each scholar faces three windows and stove, or the oblong (fig. 32), where the case is nearly similar.

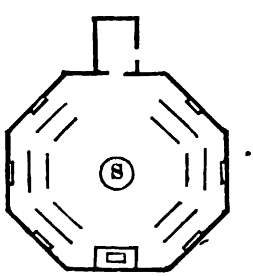


FIG. 31.

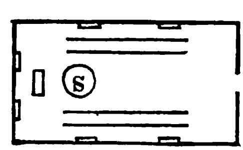


FIG. 32.

The principle that scholars should never face a light when at work is violated in the case of the long room (fig. 33) in the Union school at Schenectady. Here are seated one hundred and fifty scholars of nearly adult size, all facing in one direction. Those who occupy the forward part of the room are under great

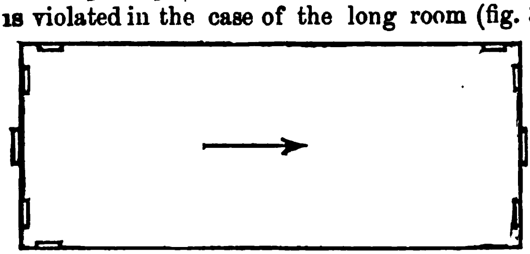


FIG. 33. Schenectady Union School.

disadvantages, as the light which comes from the rear is distant, and that in front is near. The room measures sixty-seven feet by twenty-seven feet. The building was originally a college.

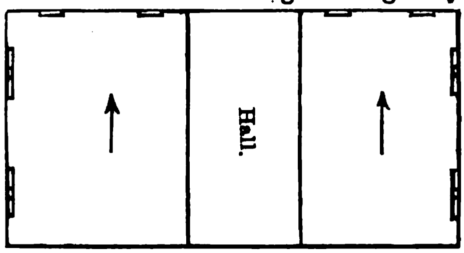


FIG. 34. Schenectady, Park Place. Facing light, needlessly.

In the newest school in Schenectady the scholars turn their backs upon a blank wall and face windows. (Fig. 34).

From Brockport State Normal School are selected two cases of bad lighting, which is dependent on the great width of the structure. It would be hard to re-arrange the inner partitions so as to give good lighting. Fig. 35 is a room used for class work, 56 by 34 feet, having all five windows at one end. Fig. 36 gives a room *devoted to drawing*, with the windows similarly placed; it is 34 feet square. And as an instance where the occupants consider the light superfluously abundant, fig. 37 is a recitation room in the third story, 32 by 18 feet, with five windows, having a glass-area—1-5.3 of the floor-area, with a free sky in front. The area of glass in fig. 35 is 1-16, and that in fig. 36 1-9.6 of the floor area. These instances are confirmatory in a general way of the principle that glass-surface should equal from 1-5 to 1-6 of the floor-surface, in all but exceptionally open places.

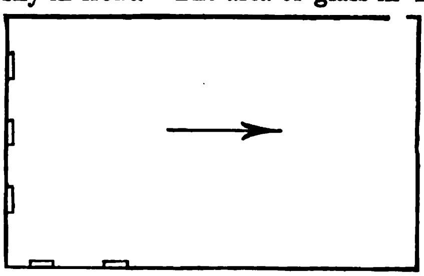


FIG. 35. (Defective lighting.) Room 56×34 with 5 windows at one end. Brockport Normal School. Windows badly placed and insufficient (glass area =1-16 of floor-area).

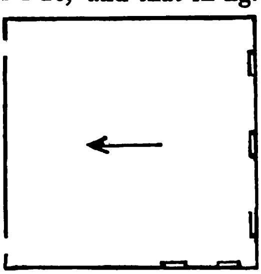


FIG. 36. (Defective lighting.) Room 34 feet square, with 5 windows. Badly placed insufficient. Brockport Normal School. Used for drawing and writing. (Glass-area=1-9.6 of floor-area.)

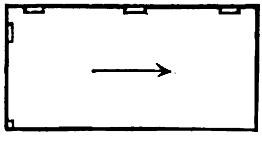


FIG. 37. (Light superabundant.) Room 32×18, windows advantageously placed, glass area=1-5.3 of floor-area, and the room looks fully upon the sky.

Fig. 38 is a room 50 by 35 feet, lighted on three sides. The large platform is placed opposite the door; hence the scholars must face four windows. For the case of this badly-arranged room the remedy is simply to reverse the position of the pupils. This would, however, give discomfort to a teacher unless a screen were used.

Fig. 39 is an old building. The lighting

of the main room is excessively bad. Nearly one half (the rear 18 feet), has no windows, and the scholars face three windows. It is not feasible to reverse the seats for that would bring the teacher's desk to D, which is quite in the dark and faces three windows. The upper story is curiously divided (fig. 40), with one room of very singular proportions: 8×12 feet.

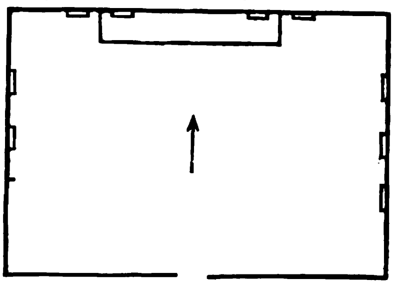


FIG. 38. (Defective lighting.) Room 50′×35′. Scholars face four windows, which have to be darkened. The width of 15 feet in middle of room is imperfectly lighted by side windows. (Rochester, No. 2.)

Fig. 41 is a one-story brick school at Brockport. With only three rooms, there are provided three entrances (R, T, W are the vestibules). Room C is badly lighted. Lighting has been sacrificed to the symmetry of the plan. If the vestibule T had been dispensed with, and R S moved so as to cover the end of B, C would have gained two windows. Room A has one superfluous window, which embarrasses the occupants.

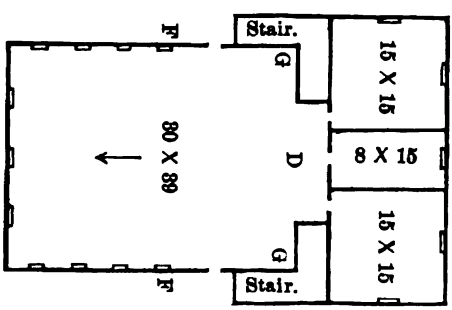


FIG. 39.

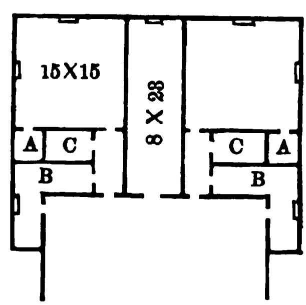


FIG. 40.

The corridor ought not to occupy the side of a house, unless that side is known to be undesirable for furnishing light. Exceptions may be made under fit circumstances. But when a house is placed on a narrow lot, under circumstances which make it even possible that the side lots may be built upon, it is folly to waste the best light (that on the street-front, in cities, may be called such) by occupying it with corridors. If it be thought necessary to use narrow lots, they should at all events run back to the next street. But the necessity does not exist in any non-metropolitan city.

One of the chief recommendations of a plan like that of fig. 28 is the freedom of exposure to the sun's direct rays. Corner rooms are wholesome to live in, and it seems undesirable to occupy that part of the plan by staircases, as in fig. 42.

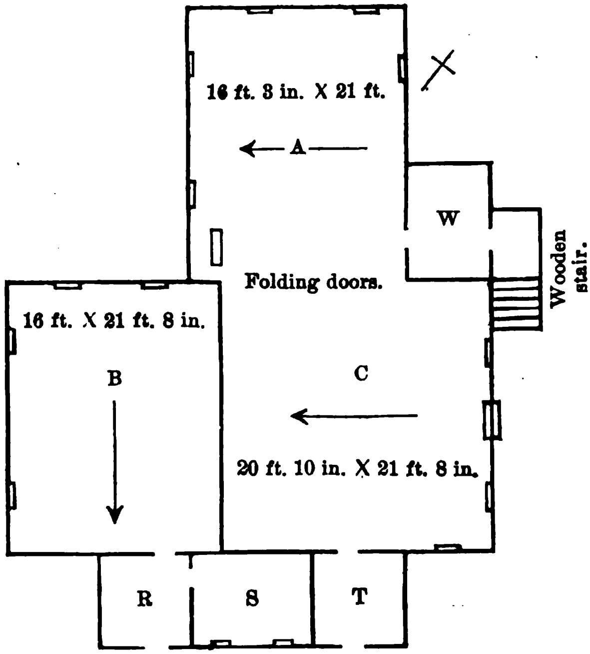


FIG. 41. Brockport Common School, floor plan.

It will be a useful exercise for any one who is concerned in the plan for a new school, to take some of the outlines here given, and try to alter them in accordance with just principles. Take fig. 42 with its simple oblong form, and try to redistribute it; with straight halls going clean through; with corner rooms, as many as convenient; with the oblong figure preserved in each room if possible; with 600 square feet floor to each, or nearly that, and more if wished; with dressing-rooms of sufficient size and properly lighted; with no room so packed as to touch other rooms on more than two sides.

The dimensions of rooms for study should not be excessive in either direction. Very large rooms cannot be lighted from one side, which is desirable in order to avoid cross-light. If both sides are used for windows, the scholars necessarily receive light, one-half from the right hand and one-half from the left. The former is objectionable in writing or drawing because the hand throws a shadow on the page. The ideal room is lighted from one side only (Fig. 9), and its size is limited by this one condition; for the height of such a room cannot be placed at more than fourteen feet, and this limits the available width of the room (equals one and one-half times the height of windows) to twenty or twenty-one feet. The width of an aisle being added on the

inner side gives twenty-four feet as the maximum desirable width for an ordinary schoolroom. The dimension in the other direction may be greater but is limited by the need of having all the children read words on the blackboard. Thirty-two by twenty-four, and fourteen in height, gives a cubic space of 10,752 feet.

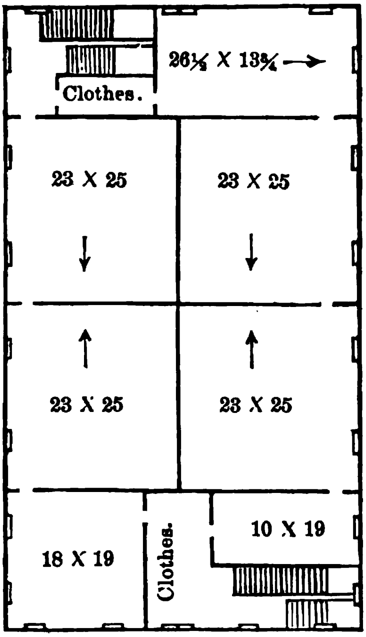


FIG. 42. School No. 14, 2d story.

The next step is to ascertain how many scholars may safely be placed in the room. That depends on the amount of fresh air that can be introduced. It may be assumed that it will not cause dangerous draughts to bring in enough air (in suitable ways) to change the entire atmosphere once in ten minutes, or six times in an hour. The hourly supply is therefore 64,512 cubic feet of fresh air. Divide this by 1,800, the quantity assumed as required by each schoolboy, and it follows that thirty-six pupils can be accommodated with sufficient fresh air in that room. In this case each scholar has 300 cubic feet of space.

If we assume that air may be admitted more rapidly, viz., so as to change the contents of the room eight times in an hour (which is probably near the maximum of safety), the result is forty-eight pupils and 225 cubic feet of space to each.

If a larger class must be accommodated, the room may be lengthened. A room 25x35 accommodates fifty-four pupils with the above allowance.

The committee of award in the competition for the prize for the best school-house plan (offered by the "Sanitary Engineer") assigned fifteen square feet of floor area as the minimum for each scholar, and the maximum height of rooms as fourteen feet, making a minimum of 210 cubic feet of space with this height, 196 feet with a height of thirteen feet, and so on.

School Desks and Seats.

There is difficulty in ascertaining what is wanted in the case of these articles. Some think that ease and a comfortable support for the body constitute the chief object of a seat; they naturally prefer a seat which tilts back a little, or compels the reader to do so. Others wish the

habit of sitting upright to be enforced by the construction of the seat and desk; the inferences drawn from this postulate are various, some wishing to do away with chair backs altogether, and others allowing a support only as far up as the middle of the back, while a narrow strip for the spine alone is used in some (foreign) patterns.

The writer would beg to be excused from deciding between these conflicting views. The truth seems to be that it is desirable for children to be taught how to write in an erect attitude, and that certain of the school chairs, with sloped and curved backs, which are now so common in modern schools, do not assist in doing this, but have rather the contrary effect of tempting to slide into a semi-recumbent posture. Such chairs are not the best to write in, however comfortable for reading. Drawing, copying, ciphering, written exercises, writing (spelling) from dictation, writing in copy-books, and the use of dictionaries, all require an upright position. The shape of a Mexican saddle may suggest something when we are trying to fix on the proper school seat. The lower half or third of the trunk is the part which needs firm support; and the lower eight or ten inches of the back-rest is the most important portion.

The desk is used for two very distinct purposes. In writing it must be nearly flat, and its edge should project an inch or two over the front edge of the chair (supposed to be of ordinary width), and the height should be convenient, so that the arms may slide easily over it without raising the shoulders. Too great height of the lid is a common fault.

In reading, it is convenient to have the desk lid tilted a good deal. Desks are now made (very cheap and good) which enable the scholar to make the change at will.

A point much neglected is the height of the seat for little children, who often have to sit with their feet off the floor.

A desk placed too far from the seat compels the pupil to lean the body forward, elbows on the desk, in postures which are apt to become injurious to the symmetry of the body. There should not be room enough to stand between desks and chairs; on the contrary, as before said, the former should overlap the latter.

The development of near-sight is aided by desks, seats, and habits of sitting or writing, which bring the head into a bent position, and the eyes close to the paper. These habits of attitude are extremely common, and nothing is more troublesome than the constant effort to correct them. In fact, nature will assert herself in spite of our efforts, and the best plan may be to cut short the time for writing, or to interrupt it by a minute devoted to calisthenics. In fact, protracted sitting, or confinement to any single posture for more than a few min-

utes, is an injurious thing. The circulation is made stagnant. Odd or distorted attitudes become more so, and the effort to maintain a correct posture becomes irksome.

In the case of a school session of three hours, it should be a serious aim to provide means for checking the continuity of application at times. In certain schools primary children are kept for nearly this time without recess. Such a plan if it implies continuous affliction of mind, is an absurdity, not to say an impossibility.

If young children must be kept at school for four hours together, it is necessary to break the continuity of work by a long recess of twenty or thirty minutes. They should not be allowed, either, to remain in their seats during recesses, but should all be sent out to play, under the care of teachers.

Much more might be said of the excess of work which is required of young children Six hours is still a common requirement, and the shortening of the afternoon session by *one* hour is rather a recent step in the right direction. Until lately, it has been simply taken for granted that the little ones should go and return when the older ones do. The presumption, however, is entirely in the opposite direction. A child of six years should no more be expected to keep the same school-hours as one of twelve or fourteen, than it should be allowed to have the same time for going to bed. The experience of many excellent and conscientious teachers, shows that primary scholars can very rarely be kept at work — real work — more than three hours a day. If the sessions are longer, the children have to be amused, or allowed to amuse themselves. Further consideration of this point is not, called for in this place.

NOTES ON CONTAGIOUS DISEASES OF THE EYES

IN

SCHOOLS AND ASYLUMS.*

By Cornelius R. Agnew, A. M., M. D., New York.

Clinical Professor, Diseases of the Eye and Ear, College of Physicians and Surgeons, New York. Surgeon to Manhattan Eye and Ear Hospital, etc., etc.

Many evils exist in the method of treating children upon the congregate plan in schools and reformatories. I propose in the following brief chapter to call attention to one of them which does not seem to attract the attention its gravity demands. I refer to communicable eye disease. I constantly see in my practice at the Manhattan Eye and Ear Hospital, New York, and elsewhere, patients who have contracted these diseases and got as a consequence, some lesion of the palpebral conjunctiva or cornea, which has either resulted in blindness or such impairment of vision, or of the power of endurance of their eyes, as to reduce greatly the industrial capacity of the individual.

Diseases of the conjunctiva, and of the cornea are largely the cause of prevailing blindness, and yet they belong in a great degree to the class of preventable diseases. The fact that they do fall into this class gives to the sanitarian and to the legislators a special opportunity and advantage for inquiry, advice, and legal enactment to limit or prevent their prevalence.

Some time ago I was called to a school, in one of our counties, in which several hundred children had been gathered, chiefly from the streets of the city of New York. I found more than half the inmates suffering from a malignant type of purulent ophthalmia. The disease had rapidly become epidemic in the school and dormitories until the proper educational work of the establishment was suspended, and the insufficient energy of its entire force of teachers and nurses turned

* The occurrence of contagious ophthalmia in crowded primary schools and large asylums induced the State Board of Health to request Dr. Agnew to prepare this brief chapter of information and advice, derived from his recent and careful studies of the subject.
E. H., *Secretary of the Board.*

to fight the invader. Before I was called several cases of blindness had occurred, both among the scholars and their attendants, five children having lost both eyes and seventeen children having each lost an eye.

At my visit more than half of the inmates of the school, or nearly one hundred and fifty scholars, were found suffering from acute, communicable, purulent inflammation of the eyes in its various stages. I estimated that at least five percentum of these cases would become blind from the acute processes in one or both eyes, and that a considerable number, probably one-half, would have such morbid changes produced in the conjunctiva or lining of their eyelids as would render them liable to constantly recurring inflammation, thus impairing their comfort and usefulness, lowering their industrial capacity, and threatening them with constantly impending blindness.

These children, largely of Irish parentage, had been gathered in the streets of New York, and snatched, as it was supposed, from the dangers which surrounded them. A considerable number, as I was informed, had been committed to the school through the agency of one of our most active protective societies. As I stood amid the little victims a conviction of the crudeness and ignorance which mark so many of our attempts at benevolence penetrated me. Here was a mass of little sufferers gathered from the scenes of squallor and neglect in a great city, committed to a school in which their interests, physical and religious, were supposed to be protected, but in which there was an absence of those things which were essential to their bodily health and safety. Several conditions existed in this school, favorable to the development of the horrid epidemic.

1. Imperfect quarantine.
2. Bad, or insufficient lavatories.
3. Overcrowding.
4. Bad food.
5. Bad drainage.

The mere presence of such disease in a school, or reformatory, is censurable. If it gets into, or originates there it is a serious reflection upon its management. If it spreads, it shows that the internal police of the establishment is bad. Every candidate for admission to a residential public school, or school dormitory, should be examined by an expert to ascertain whether he has a communicable eye disease. Especially should this be done in schools and reformatories maintained for the good of the poor and degraded, since it is largely among these classes that communicable eye diseases prevail. There should be a competent medical officer at the reception quarters of every such school, capable of turning the eyelids of candidates and ascertaining whether they have catarrhal affections.

It may not be possible, or wise, to turn back into society, cases of communicable eye disease, as they may have been committed for vagrancy or other good cause. Moreover, it is better that such cases should be kept where they may be skillfully treated, and thus so isolated as to cease to be the sources of dangerous contagion. Every school and reformatory should have ample provision in the form of wooden shanties or tents and play-grounds to safely treat such cases till they shall have been carried beyond the point at which they cease to be foci of disease for others.

But as these diseases, so fatal to vision, may in spite of all available caution get into the schools and become endemic, we must insist that their known causes be, so far as possible, guarded against. It is certainly competent for the State to enforce the rules which would reduce the risk of such communicable diseases occurring in all schools and reformatories that draw any portion of their maintenance from the State treasury, or exist under a State charter.

Let us, then, consider the conditions which favor the introduction into, and prevalence in, a school of such communicable eye diseases.

1. The conditions which lead to the introduction of the communicable catarrhal eye disease into a school or reformatory.

A child is taken by an agent of * * * or some other representative of law or philanthropy, and with more or less haste is run through the judicial mill and committed to a school or reformatory. If such a child has catarrhal disease of the eyes, or granular lids, the chances are that it will become a vehicle of contagion to the school. If such a child had small-pox, it would not be let loose to spread the malady in a school; and yet that disease would be comparatively harmless in a school in which vaccination had been properly done. But there is no such protection against catarrhal or purulent eye disease. The lesson, then, is that the safety of children in such institutions demands that a proper examination be made of every child before he is admitted to see whether he has catarrhal eye disease, that he may, if the disease exists, be so domiciled as not to communicate it to others.

Furthermore, as the disease may originate in a school from overcrowding and bad food, the committing parties should see to it that children are not sent to institutions in excess of their sanitary accommodations, nurses and other resources.

If a child cannot be provided in an institution with a thousand cubic feet of air in the dormitories and class rooms, and be guaranteed, also, abundance of milk and facilities for being nursed and kept clean, then it is better that it be allowed to run in the streets, getting, at least, the physical benefit of the "wild ass," till caught by the beau-

tiful hand of the Children's Aid Society or the Industrial Schools, and sent off to the West and into rural life.

2. We would now consider briefly causes which lead to the spreading of catarrhal eye diseases in such schools or reformatories.

a. *Imperfect quarantine.*
b. *Bad lavatories.*
c. *Overcrowding.*
d. *Bad food.*
e. *Bad drainage.*

a. *Imperfect Quarantine.*—We have already alluded to the necessity for examining carefully the eyes of children sent to residential schools and reformatories. This would of course involve more knowledge and care on the part of those who gather the children and commit them to the institutions. It would also involve proper provisions within such institutions, for the isolation and treatment of those who enter them with communicable ophthalmia. It is eminently *improper* to have what are commonly called ophthalmic wards of the conventional type. Such places are very defective, and tend to develop an atmosphere which soon saturates walls and furniture and to beget disgusting hospitalism. I saw, some time ago, such a night ward in a garret where the inmates had less than one hundred and seventy cubic feet of air each. Wilde, in his tract, alludes to the fact that in the epidemics referred to, the disease seemed to be reproduced most freely *at night,* and no doubt from the effects of overcrowding bad air and actual contact of individuals.

These cases should be treated, except during the coldest weather, in tents, or throughout the year in wooden shanties raised above the ground by underpinning, and with ample rooms to enable the children, so isolated from the entirely healthy inmates, to have such instruction and amusements as may be necessary for their best moral and physical interests. They should have the largest amount of out-of-door life to improve their tissue building, as defective tissue building is at the bottom of chronic ophthalmia. A healthy child getting catarrhal conjunctivitis will, as a rule, make it self limiting, and throw off the malady without any incorrigible tissue lesion if its nutritive processes are not degraded by bad hygiene.

b. *Bad Lavatories.*—It has been and still is the practice in some schools and reformatories, to have insufficient or badly arranged lavatories. The children are allowed to rush in masses into damp and reeking basements, where they wash in common. The process of washing is too often a mere smearing of the face or a rubbing of dirt

into the eyes, and then a chance grab at an omnibus-towel. In many schools and reformatories this evil has been lessened, but in very few of them has the matter of careful, separate ablutions been duly provided for. Every child should have its own place for washing, with due privacy and adequate attendance and an individual towel. Cases of "chronic sore eyes" should have distinct arrangements and ample provision made that the eyes may be gently, but thoroughly cleansed, at least twice a day, and the edges of the lids properly annointed to prevent the accumulations of secretions among the eyelashes, from which they so readily get to the eyes of others. The local treatment of the acute cases does not properly fall to be considered in this paper.

c. *Overcrowding.*—Of all the causes mentioned, it is not easy to estimate which is the worst. All sanitarians will, however, agree that overcrowding is a most fertile cause and aggravation of sickness in every variety. It is probably the most common and, therefore, the most universally damaging. *Crowd poison is a most subtle and most fatal poison.* Alcohol and syphilis produce results which attract more attention because some of them are very phenomenal, but they do not work the mischief which the presence in the atmosphere of invisible human filth does. It constantly poisons the blood of the sufferer, and *insidiously undermines his tissue-building* by day and by night.

Moreover, crowding makes it impossible to guard the sufferers against contagion and the rapid transportation of polluting secretions from a diseased eye to a well one. Flies and other insects become the conveyors of the contagium, and should be destroyed by the use of all the available traps and other means. *Light should not be excluded for this purpose, as that would enfeeble the children, and degrade their tissue-building and make the destructive effects of the disease greater.*

d. *Bad Food.*—What we have said of the effects of bad air applies in a measure also to bad food. The quality and quantity of the air supplied are closely related to the food supply. Indeed, the air we breathe is, in a very important sense, a food, or blood-making element. If the health of children in a public institution is largely due to the quantity and quality of the air which they have supplied to them, it is also very largely determined by the extent to which *milk* forms the basis of their dietary. Let children in schools and reformatories have a thousand cubic feet of air space, each, by day and by night, and all the good bread and milk that they can be made to eat and there will be insured comparatively good health. It is now as it always has been, that the badly fed are the first to fall victims to ophthalmia. I have

read the tract of the late Sir W. R. Wilde, entitled "Observations on the Epidemic Ophthalhmia, which has prevailed in the work-houses and schools of the Tipperary and Athlone unions, Dublin, 1851." In this tract great stress is laid on the relations existing between the disease and filth and starvation. He says, "the class of patients attacked were debilitated, starved female children, generally those recently admitted, worn out by previous want and privation of every kind."

e. *Bad Drainage.*—This is also a fertile cause of ill-health in public institutions. Not that we can yet safely attribute special diseases to particular germs, and say that they came up out of a sewer and seized a child by the eye or throat, and produced such and such a disease. But sewer air and polluted ground-air vitiate the atmosphere and render it unsuitable for purposes of respiration and tissue-building. The annual reports of all public institutions should contain a certificate from an expert setting forth the known condition of their water supply and sewerage, and an effort should be made to so construct all lines of drains, that they may be in sight within the buildings, and easily overhauled outside of them at the time of annual scrutiny, and report.

The children gathered in our State schools and reformatories are largely drawn from the homes of our Irish fellow-citizens, and seem to be peculiarly liable to destructive or chronic affections of the conjunciva. It must be remembered, however, that the catarrhal affection on which we are writing is very communicable, and may be easily imported into any school. A single case in a school, if not isolated, is like leaven. If the sanitary conditions of the schools are good, it may not find congenial soil, or become rooted, or spread. If, however, the school is badly lighted, damp and overcrowded, and the dietary deficient in animal food; if the dormitories are crowded and the arrangements for the daily ablutions insufficient, or the basins and towels for congregate or promiscuous use, and the drainage bad, then we may expect evil to follow. I found, even in the hospital dormitory of the school to which I first referred, less than two hundred cubic feet of air per inmate, and the atmosphere loaded with impurities.

It is with great pleasure that I say to the credit of the medical man in attendance that he had only recently been called to the charge of the school, and that he was instituting reforms with intelligence, and as rapidly as the nature of the establishment would allow.

I advised that tents should immediately be set up in the fields near by, and the sufferers scattered beneath their shelter, assuring the non-medical officers of the school that the much dreaded light and air would only have a salutary effect. I also insisted with the doctor upon the

freest use of milk in the dietary, and it was increased in quantity from fifteen to four hundred quarts. The subject seems to be of such importance that I here give a note just received from the medical man in charge, refraining, of course, from publishing either his name or that of the institution referred to, as my object in writing this paper is to do good, and not to make a sensational point against any one, or to stigmatize those whom I intend quietly to help to do better things than they are now enabled by their present knowledge and economic resources to accomplish:

December 28th, 1881.

"DR. C. R. AGNEW:

"DEAR SIR—In compliance with your request I herewith send you a statement of the condition in which I found the institution in question. I was first called April 1, 1881. A strong odor of sewer gas pervaded the building, which proceeded from several foul and entirely unventilated pan water closets, the soil pipe from which emptied by means of a leaking sewer, which was also without trap or ventilator, into an adjoining privy vault, the discharge being entirely below the water line. No fresh air was admitted to the soil pipe or sewer. The kitchen and laundry waste was discharged upon the surface of the ground, *the latter under its floor*. The institution contained 308 children crowded together in close, unventilated rooms, sunlight and air being rigidly excluded. In one sleeping apartment *above* the laundry these children were placed two and three in a bed with *less* than *one hundred and twenty-five* cubic feet of air apiece, the windows and blind being closed. Fortunately no water closets had been placed here, but two tin slop pails, placed in the center of the room, were used instead. The food was of poor quality. I believe but ten (10) quarts of milk were furnished daily. Two troughs sixteen (16) feet in length answered for a lavatory, all washing in the same water, while the few towels in use were employed indiscriminately. Sore heads were almost universal, dependent principally on the vermin inhabiting them. The itch was also very prevalent. I subsequently learned that several children had died from *cerebro-spinal meningitis*. Forty-eight (48) Children and attendants were suffering from fully developed purulent conjunctivitis. Perforation of one cornea had already taken place in three (3) cases, of both cornea in one (1) case. *Six cases had been removed to hospital. Of these*, three (3) lost both eyes. Three (3) lost one eye, each. The disease had prevailed the preceding year, just how extensively, I was unable to ascertain; but the institution still contained five (5) children who had lost both eyes, and seventeen (17) who had lost one (1), each at that time.

"*Of the remaining children scarcely one could be said to possess a healthy conjunctiva.* Between the months of April and September, since when no new cases have appeared, I treated among the inmates 129 cases of severe purulent conjunctivitis which ran their full courses, and 114 of a milder type. I this day examined 111 of those who passed through the same form with reference to the condition in which the conjunctiva has been left.

22 had healthy lids.
56 granular lids.
33 chronic conjunctivitis.

"Many of the latter have hypertrophoid papillae, and I think that when they subside the granulations will appear. Except the cases before mentioned, but one (1) child had perforation of the cornea. Under the directions of an experienced sanitary engineer, all of the old closets, plumbing and sewers were removed, new means of drainage introduced, and the premises placed in as good a sanitary condition as our present knowledge will allow. Finding it impossible to quarantine the great number of cases, the children were all placed in tents, where they remained throughout the summer and autumn. They were given as much good cows milk as they could use. Great care was exercised that no child used another's basin, towel, comb, etc. Under the influence of fresh air and good food the disease soon disappeared.

"Yours, &c., &c."

The occurrence of an epidemic of purulent ophthalmia not only produces cases of partial or entire blindness, but spoils the integrity of the lining of the eyelids. This latter condition of proliferation or thickening of the conjunctiva of the eyelids, and production of so called granulations is a most obstinate and incorrigible affection. It leads in very many cases to a life of troublesome eyes, to cloudy cornea and imperfect sight, or ultimately ulcerations, staphyloma, and possibly destruction of one or both eyes.

The bad effects of this preventable malady are not confined to the limited school life, but run through the entire career of the sufferer or make him a vehicle of contagion to others. I have often seen an entire family inoculated by the arrival in their midst of a case from a public institution. I have seen it carried into a community and there spread by a child discharged from such a school. It will be seen that we have not only the acute malady to deal with, but the baleful after effects, in blindness, chronic eye trouble and the spread of catarrhal eye disease in tenements and other communities. The authorities then, and those who make the reduction of the expenses of public char-

ities the special object of their zeal should become broader students of the matters they undertake to regulate. "There is that scattereth and yet increaseth, there is that withholdeth and yet tendeth to poverty." It would be easy to stamp out ophthalmia in public schools, if all who are interested would work in unison. We have so many societies to do charitable work, and so much pulling at cross purposes to catch each other, and to get sensational points for mutual recrimination, and so much tendency to use raw facts for temporary or selfish our political purposes that one sometimes almost despairs of eve seeing a wise and generous economy introduced. I think that schools and reformatories should be licensed by the State under a general law like that, for instance, determining the capacity of emigrant ships so that overcrowding and bad food would be impossible without a misdemeanor on the part of their managers. The license should state in terms what cubic air space must be secured for each inmate and what the dietary must be. Then no school or reformatory would have more inmates than the building should contain or its resources properly maintain, and societies for inquiry and advice would have some definite duties to perform with reference to them. The law should fix a minimum of eight hundred or one thousand cubic feet of air space for every such inmate, and at least one quart and a half of good milk, of definite purity, besides other specified food for each inmate and also determine methods of applying the principles for drainage and ventilation and out of door work and amusements.

All over our State there are schools in which the effects of over crowding and insufficient food and other preventable causes of disease are telling disastrously upon the health of their inmates, and so are seminaries, or seed places, from which legions of children go out to recruit the ranks of long-lived paupers. There are also, as I well know near this city, New York, institutions against which I make no complaint and I purposely avoid any injudicious criticisms or comparisons.

REPORT OF STANDING COMMITTEE ON QUARANTINE, EXTERNAL AND INTERNAL.

The first known maritime quarantine regulations were adopted by Venice in the year 1448, then at the height of her commercial and political prosperity; since that time almost every civilized government has, from time to time, resorted to measures which restrained the commercial and social intercourse of its citizens, in order to prevent the introduction and propagation of infectious and contagious diseases. The necessity of sanitary regulations and quarantine restrictions among communities was recognized in ancient, as well as modern, times. Sanitary work as preventive measures seems to have largely taken the place of curative agencies among the ancient Jews; physicians, or persons devoted to the medical art, were unknown; the priesthood discharged such offices as a part of their religious duties. "All the days wherein the plague shall be in him, he shall be defiled; he is unclean; he shall dwell alone; without the camp shall his habitation be."—Levit., 13–46. The laws for the cleansing of persons, their perfect isolation when suffering from contagious diseases, the relentless destruction of everything that communicated infection or contagion, adopted and executed under the wonderful system established by the Jewish lawgiver, may justly excite the admiration of modern sanitarians. The most eminent statesmen and jurists of our own age and country, have approved the restrictive measures necessary for the protection of the public health.

"Health and quarantine laws have been continually passed by the State since the adoption of the constitution," says Chief Justice Taney, "and the power to pass them recognized by acts of Congress, and the revenue officer of the general government directed to assist in their execution."

The character of the restrictions has differed as widely as the diseases against which they have sought to guard. The earlier medical observers, believing in personal contagion as the source of propagation of this class of diseases, directed preventive measures, chiefly to the inhibition of communication with the diseased, or those who had been exposed to the contagion supposed to arise from them. The history of epidemics in so far as relates to their progress from one community and country to another, gives some reason for this belief; for their march is along the great highways of human intercourse—some over continental spaces, while others make their approach by the sea. The embarrassments to commerce which attend the imposition of quarantine restrictions is principally experienced at the maritime approaches to our great cities.

The cities of the eastern continent have, for ages, established a *cordon sanitaire* against those fearful pestilences known as plague and cholera, while the cities of the western world have sought, by quarantine restrictions, established at the entrance to our ports, to guard with equal vigilance against that disease, which for a long period has been naturalized in many of the islands of the West Indies, known as yellow fever. It was with special reference to yellow fever and small-pox that the earliest legislation in the nature of a quarantine act was passed by the colonial legislature of the province of New York, in the year 1755.

Numerous acts of the council previous to that time attest the anxiety and efforts of the authorities to prevent the introduction of the disease mentioned. Not only were restraints imposed, and penalties decreed for their violation, but solemn fasts were proclaimed "to divert Almighty God's present and impending judgments." Notwithstanding these, the city of New York and adjacent localities were almost yearly visited by epidemics of yellow fever, during the latter part of the last, and the early part of the present century. Seventeen invasions of the disease are reported to have been suffered previous to 1811, notwithstanding the enactments of councils and legislatures, and the prayers of the people.

That these might have been, and, with the aid of the sanitary knowledge of to-day, would have been arrested, the history of the New York Quarantine conclusively proves.

The opportunities for the admission of infectious diseases into the city, through the great waterway of the port, have been vastly increased since the time when yellow fever was an annual visitor there. Its commerce has increased a thousand fold, and its proximity to the home of he pestilence has been nearer, through the rapid transit afforded by steam vessels. It may be truthfully asserted that no other port in the world is more exposed to the approach of pestilential diseases than the port of New York. The extent of its commercial relations; the short time occupied in the passage of steamships from the tropical haunts of yellow fever, and the immense number of immigrants entering the city from all quarters of the globe, combine to make it the most exposed of the great highways of ocean commerce.

Populous cities environ the port, from which radiate arteries of commerce and travel through a vast territorial area, distributing the wealth and population of an empire.

The vigilance of the quarantine at the port of New York, which prevents the admission of infectious or contagious disease into New York city, guards not only the health of the immediate vicinity, but in a measure shields the cities, villages and remotest hamlets of a continent.

Less important, but worthy of consideration is the influence of its quarantine, directly or indirectly, upon the material prosperity of a considerable portion of the people at the seaboard, and thence through established commercial relations with millions in the interior. An epidemic of contagious or infectious disease in the commercial metropolis, like the lesion of a great nerve centre, arrests the influence of the creative power, and paralyzes every member with which it is connected. And to carry the figure still further, the flow of commercial intercourse, like the vital current returning from the paralyzed extremities, is tardy in movement and insufficient in quality and quantity, to invigorate and restore the original prosperity of the one, or the health of the other. The

diseases against which quarantines are established, are public enemies which not only sacrifice human life and health, but cripple every industry.

Thus, owing to the annual epidemic of yellow fever which prevails at Havana and other ports of the West Indies, commerce is greatly restricted during a portion of the year, and the population reduced by the hegira of unacclimated residents. The embargo which disease lays upon the commercial prosperity of New Orleans may be instanced as an example of its effects in our own country. Some of the regular steamship lines are withdrawn from that port during the active quarantine season, between May and October; and a great number of sailing vessels that trade to New Orleans at other seasons of the year, during this period seek other and more healthy ports.

The extent of the disastrous influence which yellow fever may cause in this country, was illustrated by the epidemic of 1878, when 20,000 people were its victims, and 120,000 persons were stricken with it. The magnitude of the financial loss in this one epidemic can scarcely be estimated. Reference to this disease is made because it particularly illustrates the necessity and value of an efficient maritime quarantine. It has passed beyond the limits of argument into the realm of demonstration that this disease may be wholly arrested in its approach to our shores by a vigilant quarantine along the seaboard.

Under certain circumstances the operations of quarantine may, and should be not only unobtrusive, but unseen by the public. It is better, when the tidal movement of a great epidemic, such as has frequently approached the very threshold of the city of New York, and has been quietly arrested and confined to the limits of the quarantine hospital, that the public should have no opportunity to indulge unnecessary apprehensions.

The history of the New York quarantine is one of growth. It commenced at a period when scarcely more than the rudiments of sanitary science were understood; when contagion and infection were little comprehended, and were often confused in the minds of medical observers, and when the measures which were employed to arrest disease, became the means of its extension to other victims.

The idea of personal contagion was so established in the minds of medical men at the beginning of the present century, that the instructive lessons which should have been taught by each of the rapidly succeeding epidemics of yellow fever were of no avail. It seems for a long time not to have occurred to the health authorities of the port and city that the cause existed, and grew by propagation entirely independent of personal contact or communication.

The quarantine law of 1811 required that "all vessels with yellow fever or any other pestilential disease on board, or hailing from ports where yellow fever prevailed, should discharge cargo in quarantine," *and to remain in quarantine thirty days.* And all passengers and sailors on such vessels were detained *for twenty days* after the last exposure to such disease. Considered by the light of modern sanitary laws, no better plan could have been devised to perpetuate the disease among the unfortunate passengers and crew, than their detention for twenty days on an infected ship, or one on which the imperfect process of disinfection was in progress. It was not until 1830, that the law allowed

healthy persons in vessels from infected ports to go to the city on arrival. The law required that infected vessels should be "washed in vinegar and white-washed three times."

The epidemic of yellow fever which prevailed in New York in 1822 first developed at the foot of Rector street, and was alleged to have come from one or the other, or both, of two vessels or their cargoes from Havana, named *Spanish Soldier* and *Eliza Jane.*

Other evidence exists showing that another vessel, which had introduced yellow fever from Key West to St. Augustine, lay at the Rector street dock, and several of the persons employed on the vessel were among the first to suffer from the disease. The origin and development of the epidemic gave evidence of the still insufficient measures which were practiced in the cleansing and disinfection of vessels.

The progress of the disease at this invasion is interesting, and affords lessons in the etiology of the disease by which the medical observers of the times and their successors to the present time have profited. Early in July, the first case was developed. Steadily, but slowly, the infection advanced along the street toward Broadway. The street was barricaded; the barriers were extended, and the infection spread correspondingly. Families living on the street were warned of the approach of the infection and advised to remove within a certain period; many fled, and others unheeding the danger, or hesitating too long, became victims. One other centre of infection seems to have been established in Mulberry street during the epidemic, but it was limited in its area and effect. With this exception, the five hundred cases which occurred, many in other parts of the city, were traceable to contact with the infected district.

The law which required "all vessels with yellow fever, or any other pestilential disease on board, or hailing from ports where yellow fever prevailed," to quarantine thirty days, was in direct violation of principles which at the present time are recognized as the most successful in the administration of quarantine.

Its immediate result was great embarrassment to commercial interests, and its secondary effect was the transmission of disease from one vessel to another, and to the people on adjacent shores.

During the epidemic of yellow fever, which prevailed in 1856, upward of two hundred vessels were at one time under quarantine restrictions, and anchored between the Narrows and Robbin's reef. It is not surprising that the population of both shores of the bay of New York, were at this time decimated by the pestilence.

With this brief glance at the New York Quarantine as it has been, it will not be improper to consider its present methods for securing not only to New York city, and its populous environs, but as well to the far and near populations of the interior, first, the utmost possible exemption from contagious and infectious disease, and second, the least embarrassment to its great commerce and immense passenger travel, consistent with the desired protection from disease.

For nearly twenty-five years last past yellow fever has obtained no serious foothold by admission through the port of New York. Every year during that period it has sought admission in numerous instances, and in different ways; sometimes through the stricken victim and his infected baggage or clothing; oftener lurking in the darkness of the hold, or the filth of the bilge.

Since the occupation of the present quarantine hospital, now twelve years, nearly four hundred cases of yellow fever have been arrested at the threshold of the port, and provided for at the Quarantine Hospital. The head boards at Seguine's Point number 286; a large majority of which mark the resting place of its victims. The number of cases of small-pox discovered during these years, assuming that the past two years furnish a basis for an average for the last twelve, has been 1,248, which were removed from 648 incoming vessels.

The exposure of New York to infectious and contagious diseases through its relation to the tropical ports, and the vast emigration passing through it, has been referred to. But the local conditions which favor the propagation of infectious disease when once established, have not been considered. At a time when partisan interests are seeking to magnify the unsanitary conditions referred to, it may not be wise to make more than a passing allusion to these. The comparatively high death rate of this city, at the present time ($35\frac{22}{100}$ in the last quarter of the present year) renders its degradation marked, in the health scales of the great cities of the world.

The fault is not so much in the officials who represent the interests of the people at the Board of Health, nor is it to any considerable extent chargeable to the condition of the streets. The cause is beyond this, and dates to the defective system of drainage adopted in the early history of the city.

In many of the older portions of New York there are no adequate sewer connections; if these ever existed, their connections with the main sewer have become defective to such an extent, that in some instances the sewage never reaches them. The occupants of every boarding-house, hotel, or other domicile in this condition, is in danger from disease; waste material and excrementitious matter saturate the soil, until foul gas freighted with disease-producing germs fills the air, which, instead of giving renewed vitality and vigor to human life, impregnate the people with the elements of disease and death. But it is in the condition of the wharves and docks, decaying wooden structures and accumulated filth in adjacent streets, that infection germs would find a congenial home. Dr. Sternberg, surgeon U. S. A., in his recent highly interesting and instructive "Experimental Investigations relating to the Etiology of Malarial Fevers," says: "The fact observed by myself, that during the summer months the mud in the gutters of New Orleans possesses an extraordinary degree of virulence, shows that pathogenic varieties of bacteria are not alone bred in the bodies of living animals. The more I study this subject, the more probable it seems to me that in this direction lies the explanation of many problems which have puzzled epidemiologists, and that the sanitarians are right in fighting against filth as a prime factor in the production of epidemics — a factor of which the *role* is easily understood if correct."

The extent of the shore line occupied by wharves within the city limits of New York and Brooklyn, is nearly twenty-four miles. Much of this distance under favorable circumstances, such as moisture, and a prolonged summer temperature, would supply conditions well adapted to the rapid propagation of infectious germs. It is not in improved sanitary conditions alone that these cities must look for safety from infectious and contagious diseases, that almost daily during a portion

of the year seek admission in one form or another; but in the systematic and efficient management of the quarantine that sits at the gateway of their ocean commerce.

If, during a period of a *quarter of a century*, the methods and measures which are adopted in the administration of the New York quarantine have not only prevented the introduction of any epidemic of contagious or infectious disease, and instead of being as formerly, a grievous embarrassment, have been able to lighten the burdens of commerce, it is fair to assume that a vigilant and judicious exercise of the same means will secure results in the future equally satisfactory in the protection of life, health, and material interests.

The law which required that vessels with disease on board, or hailing from ports where yellow fever prevails, should quarantine thirty days, and all passengers and sailors on board such vessels be detained twelve days, was repealed by the statute of 1830, so far as to allow passengers to go to the city without baggage, but subject to the discretion of the health officer.

Chapter three hundred and fifty-eight of the laws of 1863, declares that, "if a vessel, though not having had during the voyage any case of quarantinable disease, yet be found in a condition which the health officer shall deem dangerous to the public health, the vessel and cargo shall be detained until the case shall have been considered; the decision of the health officer, however, in all such cases shall be rendered within twenty-four hours. Vessels in an unhealthy state shall not be allowed *pratique* until they shall have broken out, duly cleansed and ventilated." The provisions are essentially the same, except that the health officer is made the judge of the time necessary for the detention of vessels. This power was exercised by the health officer during the epidemic of 1856 with terrible results. Vessels were closely anchored, and frequently cabled together all the way from the narrows to the discharging anchorage between Robbin's reef and Bedloe's Island. Infected vessels thus detained without discharge of cargo, exposed to the influences of accumulated filth, and a high temperature, became pest ships, which distributed the infection to passing vessels, and the adjacent shores.

To whom the credit of inaugurating the change in quarantine management is due, which secured the prompt discharge of the cargoes from vessels, and the early separation of passengers and crew, there is some doubt. It is certain that there were quarantine officials who entered protest.

Doctor Elisha Harris, late "physician-in-chief" at quarantine, in reply to inquiries addressed by the quarantine commission in 1858, and transmitted to the governor, March 10, 1858, declared that "the accumulation of a large amount of infected materials without complete ventilation, or the close aggregation of a large number of infected vessels with their cargoes, in the absence of other ventilation than that attainable on shipboard, would, during any of the summer months, constitute a *pest embankment*, dangerous to all persons and vessels coming in near proximity thereto. * * * * And the fewer the vessels that remain at the quarantine anchorage, the better for the public safety, as well as for the interests of commerce."

It is quite probable that the terrible lesson, taught by the management of quarantine during the epidemic of 1856, was remembered, and that it influenced the change in no inconsiderable degree.

The appointment of Doctor S. O. Vanderpoel as health officer in 1872, was signalized by other changes which still farther relieved the burden which quarantine imposed without increasing the exposure of the port to the introduction of disease. One of the principal of these was the admission of lightered goods from the quarantined vessels directly to the warehouse of the consignee or owner, without the expense of storage at an intermediate warehouse. This relief from the additional expense incurred in removal, and the excessive charges which the monopoly stimulated, was greatly appreciated by the shipping merchants.

Slowly under the teachings of experience, the management of quarantine emerged from the cloud of imperfect measures, which in the early part of the century were productive of unsatisfactory, and, sometimes disastrous results through the admission of infectious disease to the city, which sometimes assumed epidemic proportions, to the adoption of a system which has thus far secured absolute protection from the invasion of yellow fever, and so far as possible through the action of the quarantine officials of the port, from other quarantinable diseases, and without any considerable embarrassment to the travel or commerce entering the port.

Vessels from infected ports, or with the suspicion of infection, arising from sickness on board, while at or in transit from the port of departure, are immediately discharged of cargo, cleaned and disinfected. It is evident that the disease-producing germ once destroyed, there is as little danger from propagation of the disease in twelve hours thereafter, as in twelve days. The measures adopted to secure this result were stated with some detail, in a communication published in the report of the New York State Board of Health for 1880. A brief extract from that article will be proper.

"If there is sickness of a suspicious character, the sick are removed to the quarantine hospital. If the ship is less than five days from a port infected with yellow fever, passengers and vessel are held until that period has fully elapsed. In the meantime the hatches are opened, the cargo and steerage are fumigated twice, at intervals of several hours, with chlorine or sulphurous acid gas.

"All baggage, mails, and whatever articles liable to have become infected are put in a close apartment and submitted to disinfection by the agents mentioned. This done, the master of the vessel is given the annexed form of 'permit,' and directed to the discharging anchorage in the upper bay, distant three miles from the city:

Permits will be issued by the health officer on this blank.

PORT OF NEW YORK.

Quarantine 188

The from is permitted to proceed to quarantine anchorage, between Robin's Reef lighthouse and Bedloe's Island, and discharge cargo on lighters, subject to accompanying regulations.

When discharged, the captain is directed to report to the health officer on Staten Island.

....

Health Officer.

The pilot is directed to anchor this vessel out of the track of ferry boats and away from the ship channel. In case of failure or neglect to do this, the vessel will be required to move before she is permitted to discharge.

"Here, under the constant supervision of the quarantine police, and the frequent visitation of the health officer, the most perfect system of cleanliness is enforced.

"The exposure of the cargo to air in its transit to the dock, serves still further to remove the danger of infection. There is no instance of the propagation of disease from that source in the history of quarantine at the port of New York. The cargo removed, the hold is now thoroughly washed, and in the case of sailing vessels the 'limber-streaks' along the kelson taken up, accumulations of filth removed, and the air spaces washed down, until the water returns clear of any evidence of impurity.

"A solution of sulphate of iron, of the strength above indicated, is now used, with which to scrub and rinse the entire hold, inclusive of the 'air spaces' and 'limber streaks.' Finally, from fifty to one hundred pounds of sulphur, according to the size of the vessel, are burned under the hatches, which are closely covered.

"The ship's crew is now mustered, and examined as they pass before the health officer. If all are well the vessel is allowed to proceed to her dock without further delay. It is proper to remark that in vessels suspected of yellow fever infection, the crew is not allowed to discharge cargo, or if they do, are submitted to a quarantine of observation for five or six days.

"It is difficult to discover how the disinfection could be more thorough, or the sanitary condition more satisfactory by a longer delay than sufficient to accomplish the results mentioned."

While the fullest protection from imported infection is secured by these means, the interests of shipping merchants are disturbed to a very limited extent. Steamships of 2,000 tons are discharged of cargo by lighters, the vessel cleaned, disinfected and restored to commerce within two or three days after arrival at the discharging anchorage.

If the year 1880 affords a basis for a fair average, and it is believed it does, the number of vessels examined between May 1st and November 1st at the New York quarantine during the last ten years from ports subject to yellow fever, is 9,880.

The number of sick on these vessels at the port of departure, during the passage, to New York, and at quarantine for the same period, is 1,640.

Report of Lower Quarantine for 1881.

INFECTED PORTS.	No. of vessels arriving from infected ports.	No. of vessels arriving with sickness.	NUMBER OF SICK. In port of departure.	On the passage to New York.	In Quarantine.	NUMBER OF DEATHS In port of departure.	On the passage to New York.	In Quarantine.	Remarks.
Angostura	3	2	1	2	..	1	1	..	
Bahia	3	3	..	..	..	..	..	..	
Barbadoes	25	..	..	..	..	..	..	..	
Cienfuegos	8	3	6	1	..	2	1	..	
Cardenas	8	..	..	..	..	..	..	..	
Curacoa	5	..	..	..	..	..	..	..	
Demerara	10	2	..	4	2	..	3	..	
Guadaloupe	15	..	..	..	..	..	..	..	
Havana	88	14	19	8	5	6	3	3	
Matanzas	9	..	..	..	..	..	..	..	
Martinique	13	1	..	1	..	..	1	..	
Nuevitas	6	1	1	..	..	1	..	..	
Laguna, Mex.	4	1	..	2	..	..	1	..	
Pernambuco	9	..	..	..	..	..	..	..	
Para	5	..	..	..	..	..	..	..	
Rio Janeiro	16	3	5	..	..	3	..	..	
Santa Cruz	4	3	21	..	..	5	..	..	
Santiago de Cuba	24	1	..	5	1	..	3	..	
Sagua-la-Grande.	11	..	..	..	..	..	..	..	
Trinidad (Isle)	9	..	..	..	..	..	..	..	
Vera Cruz	15	3	..	3	..	..	2	..	
	290	37	53	26	8	18	15	3	

No. of vessels discharged in Quarantine in 1881	
Steamships	21
Ships	1
Barks	15
Brigs	9
Schooners	3
Total	49
Number vessels from Havana	36

Total No. of vessels examined between June 15, and November 1, 1881 from Ports subject to yellow fever 506

Report of Lower Quarantine for 1880.

INFECTED PORTS.	No. of vessels arriving from infected ports.	No. of vessels arriving with sickness.	NUMBER OF SICK. In port of departure.	NUMBER OF SICK. On the passage to New York.	NUMBER OF SICK. In Quarantine.	NUMBER OF DEATHS. In port of departure.	NUMBER OF DEATHS. On the passage to New York.	NUMBER OF DEATHS. In Quarantine.	Remarks.
Antiqua	3	1	2	..	..	1	..	..	
Aspinwall.......	20	5	..	19	11	..	4	4	
Aquin..........	3	2	2	7	..	..	2	..	
Barranquella....	2	1	1	..	..	10	..	..	
Bahia...........	23	5	16	..	..	..	1	..	
Havana.........	86	11	15	1	14	..	..	5	
Matanzas.......	21	..	..	..	..	..	..	..	
Nassau.........	8	..	..	..	..	..	..	..	
Nuevitas........	3	..	..	..	..	..	..	..	
Pernambuco	21	1	..	1	..	..	1	..	
Port de Paix....	7	5	15	12	1	1	5	..	
Point a Pitre, Gua-daloupe	10	1	..	1	..	..	1	..	
Rio Janeiro.....	46	9	29	6	..	7	2	..	
Santos	11	1	5	..	..	3	..	..	
Santiago de Cuba	11	1	..	1	..	..	1	..	
Saqua-la-Grande.	10	1	..	..	1	..	..	..	
San Domingo city	2	2	2	1	..	..	1	..	
Vera Cruz......	4	1	..	1	..	..	1	..	
Curacoa........	1	1	..	..	..	..	..	1	
	292	48	87	50	27	22	19	10	

No. of vessels discharged in quarantine 1880:

Steamships	26
Ships..	1
Barks....	19
Brigs....	23
Schooners..	8
Total..................................	77

Total number of vessels examined from ports subject to yellow fever, between May 15th and November 1st, 1880 968

"Rigid rules as to the length of quarantine," "fixed by legislative enactment," have been advocated as a remedy for the varying fancies of Boards of Health, and political resolutions which influence the appointment of health officers. It is not improbable that the commercial community would be protected with greater certainty from oppression by unscrupulous officials, by means of laws which prescribe a certain time for the operations connected with quarantine. Nevertheless, the wisdom of such laws is questionable. Under the direction of an intelligent and faithful officer, protection of the public health is better secured by leaving much to his discretion and judgment. Flexibility in the administration of quarantine rules and regulations often enable the quarantinist to lighten the burdens they impose. When yellow fever

prevails at Sagua-la-Grande, (Cuba), upon the proximity of the disease to the wharves, depends the decision whether or not vessels shall discharge in quarantine. Although cases of this disease were reported to this office throughout the past summer, no vessels of many that arrived from that port were required to discharge in quarantine. The distance from the town in which the cases occurred, to the wharves where vessels receive their cargoes, was sufficient to exempt them in the opinion of the health officer at New York, from the necessity of any detention except for disinfection of cargo.

It is not until the disease has assumed epidemic proportions at Havana, and invaded the wharves and shipping, that the danger-line is considered to have been reached, and vesseles are required to perform all the duties of a rigid quarantine. The time when this condition obtains, varies greatly in different years. The annexed tables will demonstrate this difference; the relief which may be afforded under the varying circumstances and extent of the development of the disease, vary accordingly.

The number of vessels entering the port from Havana in 1880 and 1881 during the season is very nearly the same.

The number of sick of yellow fever in quarantine in 1880 was somewhat more than three times the number in 1881. The total number of vessels that discharged in quarantine was less in 1881, by nearly the same ratio. The existence of yellow fever at a port is not necessarily a reason for the enforcement of all the rules and regulations of quarantine against such a port. Has the disease taken on an epidemic character, and the infection invaded the wharves or shipping of a port, are questions, the answers to which will influence the decision, and govern the disposition of vessels by the intelligent quarantinist with equal safety to the public health, and greater benefits to commercial interests, than adherence to fixed rules established by law. The treatment of the vessel, whose crew or passengers have had sickness at the port of departure or on the passage, is regulated by the history of the cases of sickness, and the condition of the vessel. The vessel on arrival being in good sanitary condition, and satisfactory evidence being given that the sickness commenced in each and every case within five or six days after leaving port, and that the sick were probably infected by communication with the shore, the vessel would be likely to obtain *pratique* after the disinfection of her cargo.

Laws which secure the right of a quarantine officer to impose restrictions, and which protect him in the exercise of such duties as experience has demonstrated are necessary, leaving much to his judgment, will contribute more to the protection of both the health and wealth of the people, than laws which do not admit of the exercise of discretion in their administration.

Yellow fever has prevailed much less than usual in the West Indies during the past summer. Nine hundred and sixty-eight vessels were examined from ports subject to yellow fever in 1880, and five hundred and ninety-six in 1881. One hundred and thirty-seven cases occurred in port or on the passage in the former, and seventy-nine cases in the latter year. The New York quarantine has been exceptionally free from the disease during the present year. The same causes doubtless, which have limited its development in its usual habitats, have contributed

to prevent its introduction into the United States. Key West has the unenviable distinction of being the only locality in which it has developed.

Small-pox has, for reasons that will be noticed, come to be the most difficult and vexatious problem with which the quarantine authorities at the port of New York have to deal.

Early in the administration of the present health officer at the port of New York, the "human flood," that in unparalleled measure was deluging the country with the surplus population of the Old World, became a source of anxiety and apprehension that diseases of a contagious character in a latent condition would find their way through the maritime quarantines of the United States to the populations of the interior. Under this impression a circular letter, dated May 20, 1880, was addressed to the health authorities at the principal distributing points for immigrants in this country, reminding them that however great the vigilance of the authorities at the seaboard, the germs of disease were liable to pass such points undeveloped, and appear in the immigrant at some stopping place or distributing point in the "far west," and advising that a systematic inspection of immigrants should be undertaken at all the great centres of emigrant travel such as Buffalo, Suspension Bridge, Chicago, Pittsburgh, St. Louis, Red Wing, Omaha, Montreal, etc.

Foci for the epidemic development of the disease were manifest in several European ports of departure for immigrants, during the latter part of 1880. The comparatively long incubative period which attends the development of the contagion of small-pox, the rapid transit from ports of the Old World, the enormous proportions which immigration assumed early this year, and which gave every indication of continuing for an indefinite period, increased the concern felt by the quarantine authorities at New York.

Unlike yellow fever, whose incubative period rarely exceeds five days compelling scarcely twenty-four hours' detention of steamships at this port to complete the period which proclaims the safety of passengers, small-pox requires fourteen days for the development of the eruptive stage; four to six days longer than the average passage of steamships from European ports to New York. The immigration to the United States through this port has assumed such proportions during 1880 and 1881, that the detention of passengers of all vessels with immigrants until the completion of the incubative period, as in cases of the passenger steamships from ports infected with yellow fever, would not unfrequently result in the accumulation of ten thousand immigrants at the quarantine.

Statistics of the immigration to the United States in the last sixty years, and particularly during the past two years, are essential to a consideration of the measures necessary for the protection of the public health from such diseases as usually accompany the immigrant.

If the present hegira from the Old World to the New, is but a transient condition — the result of causes which will of necessity cease speedily, and that may not exist again for an indefinite period, it would not be so important, and for that reason less obligatory on the legislator, the philanthropist, or the sanitarian, to make laws and frame "Rules and Regulations" to prevent the admission through our maritime quarantines of diseases of an infectious and contagious character.

If, however, economic, political and territorial conditions, have made immigration to this country a probability in the future, to any such extent as in the past, legislation must be made so complete that the quarantinist will have power to compel the necessary vigilance and care on the part of owners and managers of passenger steamship lines, and the officers of ships at the port of departure, and on the passage to this port by the imposition of such restrictions at quarantine as will secure the desired result.

Within the last sixty-one years eleven millions of alien passengers have landed on our shores.

Much embarrassment is experienced from time to time during the warm season, by the character of consular and other bills of health from infected ports. In June of 1880 the governor of the Bahamas issued a proclamation declaring them infected with yellow fever. But long after reliable information had reached this Department from other sources that yellow fever prevailed at Nassau, clean bills of health from that port were issued by the consul.

August 22nd, 1880, the consul at Point-a-Pietre, Guadaloupe, declared "that the number of deaths from yellow fever far exceeded the number reported;" and that "the authorities try to suppress all information on the subject." These plain and honest declarations were as exceptional as they were instructive, and in marked contrast to the course of the consul at Martinique who, it is asserted, gave clean bills of health, long after the British consul refused to give clean bills on account of the prevalence of yellow fever at that port.

Many cases of yellow fever occurred at Key West in 1880, before the health authorities at that port acknowledged its existence in bills of health. Well marked cases of yellow fever were taken from vessels entering this port in more than one instance, during the past summer, when consular declarations were invoked by interested parties at this port to prove that the disease did not exist at the port of departure; but subsequently conclusive evidence of its existence was secured.

The conclusion has been fully established from many instances, such as have been referred to, that consular agents are too frequently influenced by commercial or other interests at the place of their official residence, to act independently in this mattter. Ignorance of the actual state of the public health, from concealment by the health authorities, undoubtedly contribute to make these occurrences more frequent.

The extensive commerce now existing between ports in which yellow fever is endemic, and the numerous ports in our own country within the yellow fever zone, demands on the part of our national representatives at ports where this disease exists, or where it is liable to occur, the utmost vigilance and conscientiousness in their reports through bills of health or otherwise.

The National Board of Health has rendered good service in correcting this difficulty at Havana. Its paid representative at that port, a physician of reputation, fills up bills of health, and the consul general certifies to the fact. This arrangement has given entire satisfaction at this port. It is to be earnestly hoped that the co-operation of the State Department at Washington will be given to enable the National Board to introduce its forms of bills of health in every port liable to be infected with yellow fever.

It is scarcely to be expected that the National Board, with only

limited financial resources, can establish medical representatives at even the principal ports of the West Indies. From consular agents, therefore, in the future, as in the past, must be obtained the only representation available for the guidance of the officers at quarantine, as to the health of the ports to which they are accredited.

The general government, through the secretary of state, has endeavored to correct this evil by urging upon consuls the necessity of a careful consideration of the character and extent of diseases prevalent within their official jurisdiction, and a conscientiously faithful representation through bills of health, of the facts in relation to contagious or infectious diseases in their locality.

The number of cases of yellow fever admitted to hospital by no means represents the extent of the danger. Should the restrictions of quarantine be relaxed or abandoned, there would be much greater inattention to sanitary conditions on vessels from infected ports, and there is little doubt that the communication of the officers and men of such vessels with the shore, would be so much greater that the sickness and consequent exposure at the port of destination would be greatly increased. The hope on the part of ship's officers of escaping detention at quarantine, by attention to hygienic conditions and restricted intercourse while at infected ports, contributes in a considerable degree to diminish the number of cases of sickness. In numerous instances vessels that touch regularly at several ports in the West Indies, during the less dangerous season, refuse to take cargo at such ports when infected, and are thus saved the detention and expense at quarantine, which it would be necessary to subject them to under other circumstances.

The cases of typho-malarial fever arriving on vessels from Port de Paix and other ports in the tropics, were particularly severe in 1880.

The bark *Treci Dubrovacki* arrived at lower quarantine from Port de Paix, with logwood, June 24th, 1880. Soon after leaving for New York (June 4th and 5th), two of her crew were taken sick, but recovered. June 6th, another seaman was taken sick and died the 10th of the same month. On the last mentioned date, six others were taken, and were sick when the vessel arrived. June 15th, the captain sickened and died the day before reaching port. There was no record of the date when others were taken sick, as the mate and a boy were all that remained able to do duty. Eleven men were sent to the quarantine hospital, of whom three died, one being moribund when admitted. Two of the crew had died on the passage. In a crew of fifteen "all told," all had been or were sick on arrival, and one-third of the number died.

September 18th, the bark *Erinagh*, from one of the ports of Hayti, navigated by ten men when she left that port, arrived at lower quarantine in tow of the steamship *City of Washington*. This vessel had eight men sick on the passage, two of whom died before reaching port. Four men and one boy were sent to hospital on arrival. When picked up by the *City of Washington*, the *Erinagh* was in a helpless condition in mid-ocean for want of well men to navigate her.

The condition of these vessels was extremely filthy. The malarial influences of this pestilential locality was superadded to the effects of the ill-conditioned cargo, and the crowded, badly ventilated and terribly foul forecastle in which sick and well were huddled together.

The brig *Oliver Cutts*, with logwood, navigated by nine men, arrived July 2d. Seven men were sick on the passage; one of whom had died

at sea; four were removed to hospital the day of arrival, and two others on the following day.

August 6th, the schooner *A. J. Fabens* entered quarantine from Port de Paix, navigated by seven men. The captain, mate and steward were sick, and were sent to hospital. On the 7th, two seamen were also removed to hospital. The condition of the *Oliver Cutts* and *A. J. Fabens* was much more cleanly than the other vessels to which reference has been made, and the cases of fever were proportionally mild in their course and fortunate in results.

The sickness on these vessels has been referred to to call attention to facts which are well known to quarantine officials, and often not a little embarrassing. Fever of this type, as also that which is known as pernicious fever, have many symptoms during the initial stages, in common with yellow fever. And as these cases usually come from localities in which yellow fever frequently occurs, or prevails as an epidemic, their admission to the city would occasion much alarm. Particularly when, as has occurred during the past season, yellow fever has been removed from the same vessel with cases of malarial and typho-malarial fever. However confident the medical officers at quarantine may be that the case is not yellow fever, it is a wise precaution, for reasons stated, to send these cases to the quarantine hospital for observation and treatment.

The cases which are designated as typho-malarial have different morbific elements which unite to produce the type mentioned. First, the "malarial" poison, whatever that may be, generally received among the marshes and low lands which border many of the ports in a tropical or semi-tropical climate, and perpetuated by the ill-condition of the cargo. The logwood and other woods which frequently constitute the cargo is usually dragged through the water some distance and stowed under the hatches thoroughly saturated with water. Second, the dietetic deficiency which often exists among seamen; and third, the insufficiently ventilated, crowded, and filthy condition of the forecastle.

The malarial element in these cases is doubtless the original cause, and the typhoid condition which gives most of the cases a serious aspect, and frequently fatal result, is the consequence of unsanitary conditions. Except those cases which entered the hospital moribund, or desperately ill, all with one exception recovered under the use of quinine, the moderate use of stimulants and a liberal supply of nourishment.

In 1821 the total number of immigrants that came to the United States was 17,512. With few exceptions, every year since has shown a marked increase, until it reached, in 1880, 673,636. Of this number 327,371 passed through the port of New York.

In the communication read at a meeting of the State Board of Health at Niagara Falls, August 11 and 12 last, the writer stated that "during the first five months of the present year (1881) 181,749 immigrants passed the New York quarantine," and that, "should the rate of immigration continue for the balance of the year, the enormous number of 400,188 will have landed at Castle Garden alone."

The estimate made falls short of the number by many thousands. During the year 1881, 441,307 steerage and 58,331 cabin passengers arrived at this port.

The mind fails, unaided by comparison, to comprehend the territorial extent of our country, and its capacity for the reception of an immi-

grant population. Its circumference, exclusive of Alaska, is 11,000 miles. In area it embraces 3,611,849 square miles. Its population, according to the census of 1880, is 50,000,000. The population according to these figures is $13\frac{8}{10}$ to the square mile. Compare this with France, and the difference is striking.

The continental area of the French Republic is 203,811 square miles — its population in round numbers is 40,000,000 giving $196\frac{2}{10}$ persons to the square mile.

The United States may multiply its present population by fourteen, and not increase its density beyond that of the French Republic at the present time. It is fair to assume that the boundless prairies of the west and north-west, the still abounding primeval forests that fringe the great lakes and crown the slopes of mountain ranges, the exhaustless mines of the Rocky mountains, "the visions of gold" in yet comparatively unknown territories, will continue to invite the immigrant for many years to come, to leave his home among the crowded populations, and the grinding political and social conditions of European governments, for the generous hospitality and princely advantages which the great American Republic offers.

The current of immigration, if not uniform, since 1820, has steadily increased to its present unparalleled proportions. A vast army without banners invades the country yearly. The cause cannot depend on accidental conditions, on some great upheaval in the political status of the nations of the Old World, or on the surplusage of population in European communities. Neither one nor all of these fully explain the causes upon which immigration to the United States depends.

Immigration, to an extent that has hitherto been unknown in the history of the world, must be considered as an established factor in the problem of our national life. Its results will not only be felt on the civilization of our age, but on its public health and wealth as well. It will be expedient therefore to lay broadly and speedily the foundation on which these may rest, by such sanitary legislation as will best secure the desired result. There is no question connected with sanitary science at the present time of greater importance to the people of the United States than the prevention of the introduction of contagious and infectious diseases through the maritime quarantines of the country. Of these diseases, small-pox at the present time gives rise to far the greatest apprehension, and demands the most immediate consideration of measures to arrest its introduction and propagation.

It has become evident that the remedy must go beyond the quarantine of arrival and reach the immigrant at the port of departure. No laws can be made by the authorities of this country which will be recognized there. It is only by imposing restrictions at quarantine in the United States, in case of the omission to take such measures for the protection of immigrants at the port of embarkation, or during the voyage, and to exercise such vigilance as will protect the well from disease, that a remedy can be secured.

The resistance which in several instances during the present year has attended the effort to vaccinate immigrant passengers at the New York quarantine, who had been exposed to the contagion of small-pox during the passage, has deterred the authorities from any attempt to compel the vaccination of unprotected immigrants, without evidence of exposure, there being no law, rule or regulation having the force of law, to author-

ize the procedure. But the right-royal welcome extended to immigrants through the laws of the United States demands in return from them a cheerful compliance with such laws as are necessary equally for the protection of the public and themselves.

Impressed with the fact that vaccination of passengers at quarantine who had become infected previous to embarking, or from exposure to the disease, during the early part of the passage, would not prevent the development of the disease, though it might modify its severity, an appeal was made through the following communication published in the New York *Tribune* and New York *Herald*, for greater vigilance and active co-operation on the part of officers of passenger steamships at the port of departure and en route to this port.

"QUARANTINE, S. I., *May* 27, 1881.

"*To Owners and Agents of Steamship Passenger Lines*: —

"In the interest of the great cities that environ the port of New York and of interior communities, constituting a population of millions of people, the undersigned considers it his duty to call the attention of the owners and agents of the passenger lines of steamships entering the port of New York to the following facts:

"The immigration at this time from European and English ports to the United States is unparalleled in its history. In many of the ports of departure, small-pox is prevailing to an unusual extent. In consequence of the great number of immigrants who are often waiting at these ports for passage, who, from circumstances, are compelled to seek immigrant lodging-houses in the most unhealthy and infectious portions of the city at the port of departûre, small-pox on board the passenger steamers on arrival at this port has been in the last four months unprecedentedly frequent.

"The cases which are developed on or before arrival at this port constitute but a small portion of the unfortunate results consequent on the extensive infection of emigrants at the port of departure. The incubative period of small-pox — fourteen days — is so much less than the average passage of steamships from many of the European and English ports to New York, that there is great danger of the disease developing far in the interior of the country. It will be apparent that no amount of vigilance at the port of New York can prevent this result, since the infected immigrant passes quarantine perfectly well. It is of importance, therefore, that the civil authorities in these ports employ every available means to prevent the infection of immigrants, and arrest the propagation of the disease. Much may be done toward securing this result by a systematic, thorough aud frequent examination of immigrant lodging-houses. A careful inspection by competent medical officers, of every immigrant, and the vaccination of all unprotected persons, will do much to accomplish this object. In the absence of either power or inclination on the part of the constituted authorities to do this, the owners and agents of steamship lines should take it into their own hands, to inspect, direct and control the movements of immigrant passengers from the time of their arrival at the port, until their departure. Under the present management it is believed that thousands of lives are imperiled and many sacrificed. These, though by far the greatest, are not the only evils which proper precautions would avert.

Passengers, except the sick who were sent to the hospital, were removed to Hoffman's Island for observation, during the usual incubation period of the disease.

"Notwithstanding the serious inconvenience to all, and the great expense to the owners, this alternative is far better than the admission of a cargo of infected immigrants to the dense population of our cities, and the crowded thoroughfares of the interior.

"Better than either would be such watchfulness and vigilance on the part of medical officers, as would secure early and complete isolation of the sick in such hospitals as would afford sufficient ventilation and comfort to the sick, and opportunity for the complete seclusion of real or suspected cases of contagious disease. Hospitals should be upon the main deck — never in the crowded steerage. When this is impracticable, they should be so located as to include port lights for light and ventilation, instead of a coop or pen hastily built between decks, and in the midst of the steerage, with ventilators which allow the escape of the infectious atmosphere surrounding the patient among the steerage passengers. Such violations of hygiene and common sense will in future be likely to subject all passengers to quarantine of observation, who may be so unfortunate as to have taken passage on steamships having small-pox on board, and provided with such hospital accommodations as have been described.

"Twice daily it should be the duty of the medical officer to visit and inspect every part of the steerage, that all cases may be detected and immediately isolated. Satisfactory evidence of this will save the owners of passenger vessels much time and expense, commercial interests in general not a little embarrassment, and the undersigned trouble and anxiety which he would be happy to escape.

"WM. M. SMITH,
"*Health Officer, port of New York.*"

When eight or ten days of incubation are given the infection, though not sufficient to develop the disease to medical officers at quarantine, the time is nevertheless long enough to put it beyond the controlling influence of vaccination. No law, State or national, could be made obligatory upon the authorities from which the immigrant embarks; and no law or ordinance existed which would authorize a quarantine officer at any port in the United States, to arrest and detain a passenger vessel for any purpose, except to ascertain whether or not quarantinable diseases existed on board. The appeal referred to, it was hoped, would stimulate the managers and owners to a system of sanitary supervision of the resorts of immigrants at the port of departure, a medical inspection of all immigrants when they embark, and the vaccination of all unprotected persons soon after they came on board. A faithful discharge of these duties, it was believed, would reduce the importation of the disease to a minimum degree, and obviate the neeessity of more restrictive measures through State or national legislation.

There were many reasons to believe that infected immigrants in whom the disease was latent, were frequently passing quarantine, and proceeding toward their destination in the interior of the country, establishing a focus of infection whenever they were overtaken by the disease, or distributing the contagion along the line of travel, until the severity of

the disease, or the accidental discovery of it by the authorities, arrested their further progress.

Impressed with this conviction, and the necessity of a careful inspection of all immigrants at the main distributing points in the interior, as also their supervision by the local health authorities for a short time after arrival, of those who stop temporarily or otherwise along the route, the following article was published in the principal New York papers, copies of which were transmitted to many of the health authorities in our Western States.

HEALTH OFFICER'S DEPARTMENT, STATE OF NEW YORK,
QUARANTINE, S. I., *June* 3, 1881.

To *Health Authorities:*

The unparalleled tide of immigration which is now flowing from the British Islands and Continental Europe to the United States, principally through the port of New York, in connection with the ascertained fact that small-pox prevails to an unusual extent at the present time in some of those countries, and at many of the ports from which emigrants embark, early created a well-grounded apprehension on the part of the health officer at the port of New York that this disease would be developed along the great highways of travel, or at the great interior foci of emigrants who have passed New York, Boston, Baltimore or Philadelphia quarantines in good health. Emigrant passenger steamships entering the port of New York with cases of small-pox in the steerage that have not been early and properly isolated, have in several instances within the last four months, been compelled to discharge their passengers at the "quarantine of observation" to await the development of vaccination or the full expiration of the incubative period of the disease. When the medical officers of steamships are able to give satisfactory evidence that cases of small-pox occurring during the passage have been properly isolated from the initial stage of development, the passengers are vaccinated, the vessel is disinfected and given pratique. It is not of necessity the emigrants on these vessels only, though quarantined, who communicate the disease to interior communities, the greater source of danger is in those who have been infected at, or even previous to, arrival at the port of departure, and reach this country previous to the period of the development of the disease. It will be apparent that the utmost vigilance on the part of quarantine officers cannot prevent the introduction of the contagion in this latent condition.

Telegraphic communication with the health authorities of the great cities through which the currents of emigration pass, notifying them of the arrival of vessels with small-pox, has been suggested as a measure which would contribute to secure early detection of those cases which develop subsequent to their passing the port quarantine.

It must be remembered that emigrants on landing immediately mingle with those that arrive on other vessels, often several thousand in number, and are frequently forwarded to their destination over the same line and upon the same train. Hence, such information would be of little practical benefit, except to secure greater vigilance in such inspection as would be proper, and indeed may be a necessity in every instance. Detention of all emigrants at the port of arrival until the expiration of the incubative period, has also been suggested as a means of

preventing the introduction of the contagion into the country. When it is considered that the number of emigrants arriving at the port of New York is, often, for successive days, several thousand, the impracticability of this expedient will be apparent. The accumulation would quickly be such that no adequate accommodations at the New York quarantine could be supplied, notwithstanding the unequalled extent and convenience of the buildings upon the artificial islands which the State has already provided for "quarantine of observation."

Experience and much earnest consideration of the subject during the past year have confirmed the opinion that a careful inspection of all emigrants at certain points west of the quarantine is essential for the protection of the country from the introduction of this form of contagious disease. Buffalo, Pittsburg, Chicago, St. Louis, Omaha, and perhaps other places, are foci where the municipal or State authorities may with great advantage establish an inspection of all emigrants. In the absence of such action on the part of the authorities referred to, the National Board of Health, it is believed, has authority under its reserved powers for the regulation of inter-State quarantines to secure the desired inspection at such distributing centers as may be necessary for the protection of adjacent States. Buffalo and Suspension Bridge in this State may be mentioned as illustrating the proper localities for such inspection. At intermediate localities, like Utica, Syracuse, Rochester, Elmira and Hornellsville, the authorities, it is hoped, will establish a careful inspection, and for a short period maintain a close supervision of all emigrants who arrive.

If this management is practiced by the health authorities along the great thoroughfares westward of the Atlantic seaboard, it is confidently believed that the introduction of contagious disease through infected emigrants will be effectually prevented. An increasing vigilance on the part of the quarantine authorities at this port may be expected, and it is to be hoped the same will be exercised at all the maritime quarantines through which emigrants pass.

WILLIAM M. SMITH,
Health Officer, Port of New York.

The New York State Board of Health recognized the danger at its meeting held on the 23d of June, 1881, and unanimously adopted the following resolutions:

"*Whereas*, It is believed that small-pox is at the present time prevailing in some of the ports of the British Islands and of Continental Europe; and

Whereas, The emigration from those countries to the United States, principally through the port of New York, is at the present time unprecedented in its extent; and recognizing the fact that the incubative period of the disease is greater than the average passage of steamships from such ports to ports in the United States, thus affording an opportunity for emigrants infected at the port of departure to pass our quarantines and reach interior communities before the development of the disease;

Resolved, That this Board request the National Board of Health, asa necessary measure of inter-State quarantine, to appoint an Inspector of Emigrants at Buffalo and Suspension Bridge, whose duty it shall be to

examine all emigrants passing through or stopping off at the place mentioned.

And this Board further respectfully recommend that the National Board of Health establish such inspections at Chicago, Pittsburgh, St. Louis and Omaha, during the epidemic prevalence of small-pox at the ports from which emigrants embark."

Thirty vessels with small-pox entered the port of New York within the first six months of the present year, freighted with upward of twenty-two thousand alien passengers, as against seven vessels during the corresponding period of 1880, with 4029 passengers.

This fact alone was sufficient cause for serious apprehension; and when considered in connection with the fact that in various ports of the United States outbreaks of small-pox were occurring with increasing frequency, particularly in the large cities of the North and West, as well as in more rural towns and villages in many States, additional measures to prevent the introduction of the disease demanded consideration. It had become evident that unless local authorities at ports of embarkation, or the owners of passenger lines, could be induced to act with greater efficiency, legislation would, and should be invoked so restrictive in its character as to compel their co-operation.

With the hope of impressing upon the managers of passenger lines at the port of New York the necessity for the examination of all immigrants immediately after they are received on board the vessel, and the vaccination of all that are insufficiently protected, a conference with the agents of most of the lines was had on the twenty-ninth of June, 1880.

At this conference the necessities and demands of the public through their representatives at the State and National Quarantines, the State and National Boards of Health, as well as the local health authorities in the interior, were clearly presented. The measures recommended for their adoption were:

1. Inspection of immigrants to discover those unprotected by vaccination.

2. The vaccination of all unprotected persons.

3. The supply of good and sufficient hospital accommodations to enable the medical officers of steamships to establish perfect isolation of developed cases of contagious disease separately from suspected cases, and from non-contagious diseases.

The conference was informed that in obedience to the necessity for protection of the lives and health of the people, and the demands of public sentiment, the National Board of Health would be likely to exercise its reserved powers, and require that all vessels, whose officers fail to make such inspection and vaccination or revaccination of unprotected passengers, should be quarantined or the passengers detained for a sufficient time to insure the development of all undeveloped cases of small-pox.

In this connection, it is proper to bear in mind that the port of New York, though the principal, is but one of several ports of entry for emigrants to the United States, and that the precautions necessary at that port are as necessary at all other such ports, in the ratio that the number of arrivals bear to those at New York. Port Huron on Lake Michigan is second only to New York in the number of aliens that pass through it into the United States. No inspection of immigrants is made

at this point, notwithstanding the well known fact that the Canadian provinces, particularly those lying in the line of travel for immigrants landing at Quebec, have been for two years past suffering from many outbreaks of small-pox, notably at Montreal.

The number of vessels "entering foreign" that were boarded and inspected during the year 1880, was 7827.

The number of foreign entries inspected in 1881 was 6929.

The number of immigrant passengers passing inspected at the New York quarantine in 1880 was 327,371.

The vessels entering the port with small-pox in 1880 were from the following ports:

Antwerp	5	Naples	3
Hamburgh	3	Liverpool	1
Bremen	2		
			14

Number of cases of small-pox on vessels in 1880—26.

The vessels entering with small-pox in 1881 were from the following ports:

Liverpool	10	Antwerp	4
London	5	Bremen	4
Havana	3	Bordeaux	1
Hamburgh	6	Perth Amboy	1
Glasgow	4	Naples	1
Havre	1		
			40

Number of cases on vessels in 1881, 78. Number of emigrants on vessels with small-pox, 34,416.

The treatment of vessels having small-pox in the steerage, has been as different as the circumstances attending the development and management of the several cases.

When satisfactory evidence is given that the case has been detected in the initial stage, and properly isolated, the steerage passengers are vaccinated, the vessel disinfected and pratique is given. In several instances where neglect on the part of the medical officers of the vessel had subjected the passengers to exposure to infection, they were detained in quarantine until the protective influence of vaccination was secured, or until the incubative period had elapsed.

The steamship *Italia* arrived at quarantine, December 19th, 1880, from Naples, and ports on the Mediterranean with 749 steerage passengers, mostly Italians. Two cases of small-pox were found in the steerage. One of these was confluent in type, and isolated chiefly through the helplessness of the victim. One corner in an angle of the steerage formed by the termination of a gangway, in an open bunk, adjoining a space between rows of bunks, along which the other passengers passed without restriction, constituted the hospital. The other, a well developed case (variola discreta,) was in the fifth or sixth day of the eruption, but was not seen by the medical officer of the steamer, until discovered by the health officer at quarantine, while examining the passengers in detail.

There could be no reasonable doubt that many of the passengers had been infected by the neglect or stupidity of the physician of the vessel. Both passengers and crew were immediately vaccinated, and the passengers removed to Hoffman's Island for observation. The fifth day after vaccination, examination was made of every passenger; in three hundred and forty-five cases the vaccina gave evidence of satisfactory results. Those in which its effect were not evident, were revaccinated.

On the ninth day, the fourth of the revaccination, the 404 in which the first vaccination gave negative results, were again examined; 147 showed promising results from the second vaccination. In 207 of those in which both vaccinations failed, there were good cicatrices from previous vaccination, or evidence of having had small-pox. These cases were believed to be protected sufficiently, and, with those in which the results of vaccination were satisfactory, were sent to Castle Garden. Fifty persons in whom vaccination had not been productive of desired results, and whose evidences of previous protection were unsatisfactory, were detained until the full incubative period elapsed.

Among those in whom, on the fifth day, vaccination seemed to be progressing favorably, two cases of varioloid developed, the seventh day after vaccination. Instances of this character have been so frequent as to afford satisfactory proof that the incubation of the infective principle of small-pox will not be arrested in its development after the third or fourth day of its incubation, though it may be modified in its character.

April 24th, 1881, the steamship *Victoria*, from London, arrived at quarantine with 925 steerage passengers. This vessel had one case of small-pox, and one of typhus; both cases were properly isolated. The case of small-pox, then in the third day of the eruption, was not detected by the ship's medical officer, until the eruption appeared. One hundred and fifty of the passengers refused to be vaccinated. After all but these had been vaccinated and sent between decks, all persuasion failing, forcible conclusions were tried with the rebellious. In the midst of great violence twelve or fifteen of the leaders of the malcontents were seized and forcibly removed to the steamboat *Gov. Fenton*, for transportation to the quarantine of observation. The remainder made haste to find the medical officers to be vaccinated.

All but two of those put aboard the *Fenton* quickly expressed their desire to be vaccinated, and were allowed to be. The two were permitted to indulge their will at Hoffman's Island fourteen days.

The *Assyrian Monarch* arrived at quarantine, April 28th, 1881 from London, with 581 steerage passengers and 86 crew. Six cases of small-pox were found on board, and were sent to hospital.

The cases had been so promptly isolated as they developed, that it was not considered necessary to detain the vessel only time enough to vaccinate the passengers and crew. Twenty-five of the firemen, however, refused to submit to vaccination. It was nearly night, and the ship was detained with the intention of removing the unvaccinated in the morning to Hoffman's Island. The following morning, all but five of those that refused, came forward and were vaccinated. The rebellious were taken to Hoffman's Island for observation.

May 7th, the eighth day after removal to the quarantine of observation, one of the five was taken sick with what proved to be a severe at-

tack of small-pox. Before the full incubative period elapsed, the four remaining members of the *Assyrian Monarch's* crew were put aboard of that vessel on her passage down the bay on the return voyage to London.

The *State of Nevada* arrived at quarantine, May 19th, 1881, from Glasgow, with 825 steerage passengers, six of whom had small-pox, varying in the eruptive stage of development from one to four days.

The most severe case had been diagnosed as varicella by the medical officer in charge. The other cases were not discovered until the passengers passed for examination before the Health Officer. The gross neglect of the medical officer of the vessel was considered sufficient warrant for the detention of the passengers for observation.

They were vaccinated and immediately removed to Hoffman's Island. Detachments of those in whom vaccination had proceeded favorably for eight to ten days were sent to Castle Garden. Several cases of small-pox developed among the passengers while under observation, and were sent to the Riverside hospital.

June first, 1881, the steamship *Denmark* arrived from London, with 965 immigrants in the steerage. Four cases of small-pox, that had been early and judiciously isolated, were found on the *Denmark*. The small-pox cases were sent to the hospital for contagious diseases at Blackwell's Island; the passengers were vaccinated; three cases of measles that had been put in ship's hospital with small-pox cases, under the apprehension that they were cases of the same disease, were sent to hospital of observation for detention and disinfection of clothing and baggage; and after thorough disinfection of the hospitals, as in every other instance, pratique was given. *June* 15, 1881, the steamship *Wisconsin* arrrived with *twelve* of *her crew* sick with small-pox. This unusual infection of a passenger steamship's crew came from a case among the crew of the vessel on the outbound passage; no precaution having been taken by the medical officer on board, to prevent the effect of the infection, by vaccination of the exposed persons.

The steamship *Britannic* with 592 passengers received at Liverpool, arrived June 19, 1881. One case of small-pox was found which had been discovered and isolated in the initial stage, by the ship's medical officer. After much persuasion, all the passengers except thirty-one were vaccinated. These, the declared adherents of anti-vaccination societies, were speedily installed at Hoffman's Island, with an assured leisure of fourteen days if not vaccinated within the first twenty-four hours after arrival.

The following day, twenty-seven reconsidered their pledges to the anti-vaccination society, were vaccinated, and send to Castle Garden. The four remaining passengers distinguished themselves with true English obstinacy, remaining under observation the full period of fourteen days.

On the day of the arrival of the *Britannic* the steamship *City of Montreal* arrived at quarantine, having 1,242 immigrants in the steerage. One case *varioloid* and one of *variola* were found, both of which, with commendable vigilance had been isolated judiciously the day before the appearance of the eruption. The case of varioloid occurred in a German 43 years of age, who had a fair vaccinal scar, from vaccination six years before. The eruption was peculiar in being abundant, but abortive, and the base of each of the ten thousand imperfect pustules that

almost covered the surface was tinged with a hemorrhagic appearance. So marked was this feature of the case, that the ship's physician diagnosed it as typhus fever. The patient had but little evidence of constitutional disturbance.

Ole Nilsson, a Swede, was found on the steamship "*Furnessia*" June 26, 1881, complaining of general *malaise*, slight headache and pain in the back. The mucous membrane of the lip showed a few enlarged papillae; the case was ordered to be strictly isolated until examined the following day by a medical officer from Quarantine, with the expression of an opinion that it was a case of varioloid, and the vessel was given *pratique*. At the examination of the case the next morning, the suspicion of the day previous was confirmed, and the man was sent to hospital. This case illustrates the insidious character of the development in many cases. Had this man arrived at quarantine a few hours earlier, no human skill or vigilance could have found evidence upon which to have based a suspicion of his having been infected.

One of the finest passenger steamships that enters the port of New York, on her first trip was unfortunate in having a case of small-pox among the steerage passengers. Assurances were given by both the captain and medical officer, that the case had been isolated previous to the appearance of the eruption. A careful examination of the patient, through an interpreter, proved that the eruption had been developed two days before discovery and isolation. The vessel was consequently detained, the passengers vaccinated, and treated as in other instances of exposure to the contagion of small-pox.

The temptation on the part of officers of passenger steamships to deceive the quarantine officer is so great, that only incessant watchfulness and application to every source of information on his part, can prevent deception.

The Hamburg steamship "*Westphalia*," with 1,012 passengers in the steerage, came into quarantine December 22, 1881. The *Westphalia* left Hamburgh December 8, touched at Queenstown the 12th, and received on board 400 passengers which the disabled steamer *Allemania* had landed there on the fourth of December. One case of small-pox had developed among the *Allemania's* passengers when they reached Queenstown. They were all vaccinated on the seventh of December.

On examination at quarantine, three-fourths of the vaccinations were found successful; many of those that had not taken, showed good evidence of protection from previous vaccination. Few were, however, revaccinated. The *Westphalia's* passengers taken at Hamburg were separated from those of the *Allemania's* throughout the voyage, but were vaccinated at Quarantine. The full incubative period after exposure to the infection from the case on the *Allemania* had passed, and the assured watchfulness and early isolation of the case on the *Westphalia* by the medical officer in charge of the *Allemania's* passengers, gave reason to believe that the contagion had not extended to other persons. Twenty-four hours before the appearance of the eruption the patient had been put in charge of a single attendant who was not allowed communication with parties outside of the patient's room. This attendant was sent to Hoffman's Island for disinfection and observation, the patient was removed to Riverside hospital, the vessel disinfected and *pratique* given.

The conference called by the State Board of Health of Illinois, of delegates from State and municipal Boards of Health to meet at Chicago the 29th of June last, to "consider and adopt measures for the united action of health authorities to prevent the introduction of small-pox into the United States, and prevent its spread from one State to another," declared that "an important factor in the importation and dissemination of small-pox is the rapidity of ocean transit" in connection with immigration. "That while the incubation period of small-pox is fourteen days, eight to twelve is the average period of the voyage of the immigrant vessel arriving at New York, where the greater number of immigrants land. It is a well ascertained fact that the immigrants reach the ports of embarkation commonly several days before the sailing of the ship." "During this interval the immigrants take lodging in the low lodging houses about the docks and wharves in which small-pox is prevalent. The result is that the unprotected immigrants become infected, and if they immediately embark they may not only reach the port of destination before the incubation period has passed, but may pass the quarantine in apparently perfect health. And, what is still more important, if such infected immigrants immediately on landing take passage on board the emigrant trains, as vast numbers do, they may reach the most distant settlements before the disease finally develops. It is quite plain that under these circumstances no amount of vigilance, in merely searching for the sick, can prevent the introduction and wide dissemination of small-pox in this country. And this conclusion has ten-fold more force when applied to the introduction of small-pox from the Dominion of Canada by means of immigrants."

The action of the Chicago conference was in many respects confirmatory of the conclusions of the health officer at New York as previously expressed in published communications to "Health Authorities," and "Owners and Managers of Passenger Lines," referred to on a preceding page.

The appeal of the conference to the National Board of Health to impose such restrictions at quarantine, as would "make obligatory upon steamship owners to cause a medical inspection of all immigrants when they embark, and vaccination of all persons found unprotected," happily supplemented that already made by the New York State Board of Health, and the health officer at New York. The recommendation to the National Board to consider the propriety of making, promulgating, and enforcing rules requiring the inspection at the port of arrival of every immigrant before landing, and of the vaccination of all persons not protected, seems to have resulted in the adoption of "Additional Rules and Regulations" by the National Board, which were approved by the President, November 14th, 1881. These revised rules, having the force of law in their administration at the maritime quarantines, may properly be introduced in this place.

Rules and Regulations for securing the best sanitary condition of vessels, including their cargoes, passengers, and crews, coming to the United States from any foreign port where any contagious or infectious disease exists.

[Prepared by the *National Board of Health*, in accordance with the provisions of an act approved June 2, 1879, entitled "An act to prevent the introduction of infectious or contagious diseases into the United States."]

Explanations.

1. The object of the following rules and regulations is to prevent the introduction into the United States of "contagious or infectious diseases."

2. The following diseases are recognized as "contagious or infectious diseases," for the purposes of these rules and regulations, viz.: Asiatic cholera, yellow fever, plague, small-pox, typhus fever, and relapsing fever.

3. An "infected" port or place, in the sense of these rules, is a port or place at which either Asiatic cholera, yellow fever, plague, small-pox, relapsing fever, or typhus fever exists.

4. To secure the "best sanitary condition" of a vessel, the following points shall be observed by the owners, agents, or master of such vessel:

A. Exclusion from the vessel, as far as possible, of persons or things known or suspected to be infected.

B. Cleanliness, dryness and ventilation of the vessel, both preliminary to loading and during the voyage.

C. Disinfection — that is, the destruction or removal of the causes of disease — which includes measures of cleanliness, ventilation, fumigation, etc.

D. The crew shall not be allowed liberty on shore after nightfall in suspected localities. They shall not be allowed to sleep on deck except under awnings. The forecastle shall be well ventilated and kept dry. Both in port and at sea the bilge shall be pumped out each morning and evening, or more frequently, if necessary. The utmost cleanliness shall be observed at sea as well as in port. Each seaman shall have two suits of underclothing. The clothing and bedding shall be aired every clear day. In tropical climates the men shall be required to wash their persons and change their underclothing every evening after work, while in port, and each working suit shall be washed, dried, and aired, after a day's use. These regulations as to clothing, airing of bedding, and ventilation, shall, as far as possible, be observed at sea as well as in port.

Rules and Regulations.

1. All merchant ships and vessels sailing from a foreign port where contagious or infectious disease exists, for any port of the United States, must obtain from the consul, vice-consul, or other consular officer of the United States, at the port of departure, or from the medical officer — where such officer has been detailed by the president for that purpose — a bill of health in duplicate, which shall set forth the sanitary history of said vessel, and that it has in all respects complied with these rules and regulations.

2. No vessel shall have more than one bill of health; but if she touches at other ports on the passage, the fact and the condition of those ports as to the existence of contagious or infectious disease shall be indorsed upon the original bill of health by the consul, vice-consul, consular officer, or medical officer of the United States.

3. The bill of health shall be in the form appended.

No.—— FORM A. PORT OF———

The United States of America — National Board of Health — Bill of Health.

I, —— ——— (the person charged to deliver the bill), at the port of ———, do hereby state that the vessel hereinafter named, clears from this port under the following circumstances:

Name of vessel: ——.	Nature (vessel of war, ship, schooner, etc.: ——.
Tonnage: ——.	Guns: ——.
Apartments for passengers, No.: ——.	Where last from: ——.
Destination: ——:	Name of captain: ——.
Name of medical officer (if any): ——.	Total number of crew: ——.
Total number of passengers 1st cabin:—; 2d cabin:—; steerage:—.	Cargo:——.

Vessel.

1. Sanitary history of the vessel: ———.
2. Sanitary condition of vessel (before and after reception of cargo, with note of any decayed wood). Note disinfection of vessel: ———.
3. Sanitary condition of cargo: ———.
4. Sanitary condition of crew: ———.
5. Sanitary condition of passengers: ———.
6. Sanitary condition of clothing, food, water, air-space, and ventilation: ———.

Port.

1. Sanitary condition of port and adjacent country—
   a. Prevailing disease (if any): ———.
   b. Number of cases of and deaths from yellow fever, Asiatic cholera, plague, small-pox, or typhus fever during the week preceding:

Number of cases of	Number of deaths from
Yellow fever: ——.	Yellow fever: ——.
Asiatic cholera: ——.	Asiatic cholera: ——.
Plague: ——.	Plague: ——.
Small-pox: ——.	Small-pox: ——.
Typhus fever:	Typhus fever: ——.

   c. Population according to last census: ———.
   d. Total deaths from all causes during preceding month: ———.

2. Any circumstances affecting the public health existing in the port of departure to be here stated: ———.

I certify that I have personally inspected said vessel, and that the above statements are correct. —— ———

(Signature of Medical Officer.)

I certify that the foregoing statements are made by —— ———, who has personally inspected said vessel; that I am satisfied that the said

statements are correct; and I do further certify that the said vessel leaves this port, bound for ——, in ——.

In witness whereof I have hereunto set my hand and the seal of office, at the port of ———, this — day of ———, 188–, — o'clock.

—— ———,

(Signature of Consul.)

4. Each consul, vice-consul, consular officer, or medical officer of the United States, in a foreign port, shall keep himself thoroughly acquainted with the sanitary condition of the port and its vicinity, especially with regard to the existence of contagious or infectious diseases, or epidemics, and shall, upon the request of the owner, agent, or master, make or cause to be made, an inspection of every ship or vessel bound to the United States, and give the bill of health required by these regulations. Vessels carrying a foreign flag shall be inspected, when practicable, in company with the consul or consular agent of the nation to which the vessel belongs.

5. The fee for such inspection shall be such as may be fixed by the secretary of the treasury.

6. The certifying authority at the port of departure shall certify whether vessels carrying passengers are provided with the means of carrying out the provisions of sections 4257 and 4263 of the revised statutes.

Sec. 4257. Every vessel so employed in transporting passengers between the United States and Europe, and having space according to law, for more than one hundred such passengers, shall have at least two ventilators to purify each apartment occupied by such passengers; one of which shall be inserted in the after part, and the other in the forward part of the apartment, and one of them shall have an exhausting cap to carry off the foul air, and the other a receiving cap to carry down the fresh air. Such ventilators shall have a capacity proportioned to the size of the apartments to be purified, viz., if the apartment will lawfully authorize the reception of 200 such passengers, the capacity of each such ventilator shall be equal to a tube of twelve inches diameter in the clear, and in proportion for larger or smaller apartments. All such ventilators shall rise at least four feet six inches above the upper deck of the vessel, and to be of the most approved form and construction. If it appears from the report to be made and approved, as provided in section forty-two hundred and seventy-two, that such vessel is equally well ventilated by any other means, such other means of ventilation shall be deemed to be a compliance with the provisions of this section.

Sec. 4263. The master of any vessel employed in transporting passengers between the United States and Europe is authorized to maintain good discipline and such habits of cleanliness among passengers as will tend to the preservation and promotion of health; and to that end he shall cause such regulations as he may adopt for this purpose to be posted up before sailing, on board such vessel, in a place accessible to such passengers, and shall keep the same so posted up during the voyage. Such master shall cause the apartments occupied by such passengers to be kept at all times in a clean, healthy state; and the owners of every such vessel so employed are required to construct the decks and all other parts of the apartments so that they can be thoroughly cleansed;

and also to provide a safe, convenient privy or water-closet, for the exclusive use of every one hundred such passengers. The master shall also, when the weather is such that the passengers can be mustered on deck with their bedding, and at such other times as he may deem necessary, cause the deck occupied by such passengers to be cleansed with chloride of lime, or some other equally efficient disinfecting agent. And for each negleet or violation of any of the provisions of this section, the master and owner of any such vessel shall be severally liable to the United States in a penalty of fifty dollars, to be recovered in any circuit or district court within the jurisdiction of which such vessel arrives or from which she is about to depart, or at any place where the owner or master may be found.

7. For the purpose of isolating the sick, especially those suffering from contagious or infectious diseases, every steamship or other passenger vessel shall have two compartments or space to be used as hospitals, one for the men and the other for women. These hospitals shall, when practicable, be constructed on the main deck, or on the deck next below the uppermost deck of the vessel.

8. Every vessel before taking on cargo or passengers shall be clean and dry, and the certifying officer may, at his discretion, require that it shall be thoroughly disinfected if last from an infected port, or if the port of departure be itself infected. The examination of the vessel as to cleanliness shall be made before the cargo is taken on, and shall extend to all accessible parts, especial care being taken to note upon the bill of health the presence of decayed wood.

9. Earth and porous stone shall not be used for ballast if avoidable.

10. Merchandise or articles known to be infected shall not be received or taken on board.

11. In case the port is infected, the certifying authority may require that the officers, crew, and passengers shall be examined by a medical officer or physician selected for that purpose, and the result reported to him not more than twenty-four hours before certifying to the bill of health.

If small-pox exists at the port, the certifying authority shall require that the medical examination above provided shall extend to all the passengers, as well as to the officers and crew, for the purpose of determining their protection against small-pox, and every person found unvaccinated, or not satisfactorily protected, shall be properly vaccinated before the vessel leaves the port, and a record of such vaccinations, including the name of each individual vaccinated, and the date of vaccination, shall be given to the master of the vessel to be by him delivered to the quarantine authority at the port of arrival.

12. Bills of health can be considered valid only when delivered within twenty-four hours last preceding departure. If the departure is delayed beyond this period the bill must be *vised* by the authority delivering it, stating whatever changes have taken place in the sanitary condition of the port, vessel, officers, crew or passengers.

13. When the port of departure or its vicinity is infected, that fact shall be noted in the bill of health, and when the sanitary or other local authority of the port declares the existence of such infection, the bill of health shall give the date of the declaration.

14. A port shall not be considered infected by reason of the existence

of contagious or infectious disease confined within the limits of the quarantine station of such port.

15. Physicians attached to sea-going vessels shall be specially charged with the duty of watching their sanitary condition and the health of their officers, crew and passengers. On arrival of the vessel they shall report to the health officer of the port the sanitary history of the voyage.

16. In case of the occurrence at sea of Asiatic cholera, yellow fever, plague, small-pox, relapsing fever, or typhus fever, the wearing apparel and bedding used by those affected with such disease shall be boiled for not less than two hours, or burnt or sunk.

17. Captains, owners, or agents of vessels shall, at the port of departure, be required to answer, under oath, to the consuls or sanitary officers all questions as to the sanitary condition of the vessel, etc.

18. Whenever any vessel shall leave an *infected* foreign port, or having on board goods or passengers coming from any place or district infected with Asiatic cholera, yellow fever, or plague, shall leave any foreign port bound for any port in the United States, the consul, consular officer, or other representative of the United States, at or near such port may, at his discretion immediately give information thereof by telegraph, to the National Board of Health, at Washington, D. C., reporting the name, date of departure, and the port of destination of such vessel. The cost of such telegrams will be paid by the National Board of Health.

19. All merchant ships or vessels from any foreign port where any contagious or infectious disease exists, and bound for any port of the United States, must present to the health officer at the quarantine station of such port, evidence that these rules and regulations have been complied with in order that such vessel may enter such port, discharge its cargo, and land its passengers.

J. L. CABELL,
President National Board of Health.

THOMAS J. TURNER,
Secretary National Board of Health.

OFFICE OF THE PRESIDENT OF THE UNITED STATES,
November 14, 1881.

The foregoing rules and regulations are hereby approved.

CHESTER A. ARTHUR.

Additional Rules and Regulations Necessary to prevent the introduction of small-pox into the United States from foreign Countries.

1. That all persons coming from or through any foreign port or place in which small-pox exists, who, after the 14th day of November, 1881, shall arrive at any port of entry within the United States, shall be subjected to examination as regards their protection from that disease, by the proper health authorities of the State within which such port lies, or in case such authorities shall fail or refuse to enforce this rule, then by some officer or other proper person, to be designated by the President of the United States.

2. That in case any person so arriving shall refuse to submit to such examination, or upon undergoing the same shall be found not sufficiently protected from small-pox, such person, and in case he or she be not

sui juris, then also the person having him or her under charge, shall be detained in quarantine until he or she shall have been properly vaccinated, or shall have passed the period of incubation from date of last exposure.

J. L. CABELL,
President National Board of Health.

THOMAS J. TURNER,
Secretary National Board of Health.

OFFICE OF THE PRESIDENT OF THE UNITED STATES,
November 14, 1881.

The foregoing additional rules and regulations are hereby approved.

CHESTER A. ARTHUR.

It is a singular fact that the National Government has provided laws for the protection of the health of the immigrant, in regulating the quality of food, ventilation, and overcrowding of vessels, but has made no provision in the location and arrangement of hospitals, for the comfort of the sick, and the security of the well from such infectious and contagious diseases, as may develop during the voyage.

There is no reasonable doubt that the location of hospitals in the steerage, in rooms along covered gangways, where the only ventilation is through openings from the hospital into the gangway, or, as in some instances, by opening the doors of such hospital rooms, allowing the vitiated and infected atmosphere to be diffused among the masses of immigrants in the steerage, or inhaled by those who are in the passages, contributes to the transportation of the germs of disease into far distant interior cities, villages and hamlets.

The steamship *Rheinania*, from Hamburg, December 4, and Plymouth, England the 11th, arrived at the New York quarantine December 24, 1881, with five hundred and ninety-five steerage passengers taken on board at Plymouth from the disabled steamship *Lessing*, which left Hamburg November 13, and put into Plymouth the 29th of November. A child was sent to hospital from the *Lessing*, November 30, with *so-called* varicella. The 14th of December, Adelaide Therberg was discovered sick with small-pox (*variola discreta*), and put in hospital. Three days later (December 17), Wilhelmina Kreem, was found sick of the same disease, and the 19th of December, Elizabeth Luden was discovered suffering from varioloid.

It is evident that the case sent to hospital at Plymouth, the 30th of November, was small-pox instead of chicken-pox, and that the case which developed on the 14th of December, was the result of infection from that case. The cases discovered the 17th and 19th undoubtedly originated from exposure to the same source. The difference in the appearance of the eruption on arrival at quarantine did not warrant the conclusion that there was any considerable difference in the time of the development of the disease. The hospital room, in which the sick were nominally isolated, was located on the starboard side of the bow of the steerage. One closed port light, less than six inches in diameter, afforded whatever of air and light the room received from the outside. A horizontal aperture four inches in diameter, and two and a half in length above the door, opening from the steerage, answered the double

purpose of admitting to the sick air vitiated with the exhalations and filth of nearly six hundred human beings who had been forty days in the steerage, and conveying to the làtter an atmosphere impregnated with the germs of a disease, than which few in the catalogue to which human kind is subject, is more certain in its effect, or more fatal in its results.

The inhumanity of such a condition; the outrage inflicted upon the people of a government that has extended so generous a welcome to the immigrants from all countries, in thus knowingly affording an opportunity to scatter the contagion of this disease far and wide, was emphatically expressed to the officers of the steamship. Results more beneficial than remonstrances, it is believed, will arise from the order which compelled the vaccination of all on board, and the transfer and detention of the steerage passengers to Ward's Island for observation, at the expense of the steamship company.

Until the adoption and promulgation of the "additional rules and regulations" by the National Board of Health, health officers at our maritime quarantines could take cognizance only of vessels which had certain infectious and contagious diseases on board, or on which there was good reason to believe the germs of infectious or contagious disease existed.

The laws establishing the methods of prevention of the introduction of small-pox into this country were not adapted to an age when the Atlantic is crossed in almost half the usual incubative period of that disease.

In compliance with the spirit of the "Rules and Regulations" referred to, and with a desire to apply them so as to make them obligatory upon steamship owners to secure a medical inspection of all immigrants when they embark, and to vaccinate all persons found unprotected, and at the same time embarrass commercial interests as little as possible, the following communication was published:

QUARANTINE, S. I., *Dec.* 24, 1881.

To Owners and Managers of Passenger Steamship Lines at the port of New York:—

The following rules and regulations have been adopted by the National Board of Health and approved by the President of the United States November 14, 1881:

1. That all persons coming from or through any foreign port or place in which small-pox exists, who after the 14th day of November, 1881, shall arrive at any port of entry within the United States, shall be subjected to examination as regards to their protection from that disease by the proper health authorities of the State within which such port lies; or in case such authorities shall fail or refuse to enforce this rule, then by some officer or other proper person to be designated by the President of the United States.

2. That in case any person so arriving shall refuse to submit to such examination or upon undergoing the same shall be found not sufficiently protected from small-pox, such person, and in case he or she be not *sui juris*, then also the person having him or her under charge, shall be detained in quarantine until he or she shall have been properly vacci-

nated, or shall have passed the period of incubation from date of last exposure.

Attention is also respectfully called to the following rule and regulation of the National Board of Health:

All merchant ships and vessels sailing from a foreign port where contagious or infectious disease exists, for any port of the United States, must obtain from the consul, vice-consul or other consular officer of the United States at the port of departure, or from the medical officer, where such officer has been detailed by the President of the United States for that purpose, a bill of health in duplicate which shall set forth the sanitary history of said vessel, and that it has in all respects complied with these rules and regulations.

Believing that protection of lives and health of the people demand the adoption of the foregoing rules and regulations, the following requirements will be made of the officers of steamships entering this port:

1. Bills of health will be required by the quarantine officials at this port in conformity with the above regulations.

2. All immigrants on arrival at quarantine will be subjected to examination as regards their protection from small-pox.

3. The examination of all immigrants by the medical officers of steamships within twenty-four hours after leaving port and the vaccination of those who gave evidence of insufficient protection through previous vaccination, will, if considered by the medical officer at quarantine to have been faithfully and intelligently performed, exempt immigrant passengers from such examination at quarantine as may be necessary to determine whether or not such passengers are protected from the effect of the contagion of small-pox, except where small-pox exists or has existed on board the vessel on the passage to this port.

4. A certificate or card in the hand of each passenger, or the parent or guardian of the passenger on which shall be written or printed "Protected" and signed by the medical officer of the steamship, will be understood to indicate that such passenger is sufficiently protected by previous vaccination or through the vaccination made on shipboard. All passengers not having such certificate will be considered and treated as exposed or unprotected.

5. The medical officers of passenger steamships will be required to verify under oath the number of persons considered protected by vaccination and small-pox.

6. All persons not protected will be vaccinated or subjected to a quarantine of observation.

The examination of such passengers as are vaccinated soon after leaving the port of departure, and shortly before entering this port to determine results, is earnestly enjoined upon medical officers.

Satisfactory evidence of adequate protection of immigrant passengers from previous vaccination, or thorough early vaccination by the medical officer of the ship, will not only contribute to the protection of the public health and security, but will promote the interests of passenger lines by saving time and expense at quarantine.

In June last the undersigned had the honor at a solicited interview with the managers of passenger steamship lines to call the attention of those interested in the transportation of passengers from ports in the British Isles aud Continental Europe to the port of New York to the necessity for great vigilance at the port of departure in the protection of

immigrants from the contagion of small-pox — "for forcing inspection of immigrants to detect those unprotected by vaccination, the vaccination of all unprotected persons within twenty-four hours after leaving port, and the adoption of a regulation requiring good and sufficient hospital accommodation, to enable the medical officers of steamships to establish perfect isolation of developed cases of contagious disease, separately from suspected cases and from non-contagious diseases." At the meeting referred to it was represented that, in view of the apprehension that existed, that infected immigrants would in numerous instances pass our maritime quarantines before the development of the disease, and in the interior of the State, or perhaps at widely separated and numerous points, in the West or Northwest, become foci for the dissemination of the disease, "the National Board of Health would be likely to ask the quarantines at our ports of entry to adopt restrictive measures not authorized by existing laws but which, authorized by the National Board and approved by the President of the United States, would have the force of law." Your prompt and cheerful response to the appeal, as evidenced in the subjoined communication, was a source of great satisfaction to the health authorities :—

NEW YORK, *July* 1, 1881.

"Dr. WILLIAM M. SMITH, Health Officer of the Port of New York, Stapleton, S. I. :—

"DEAR SIR — At a meeting of the managers of steamship companies trading to this port, at which the following lines were represented, namely : — the Cunard line, the White Star line, the Rotterdam line, the Guion line, the North German Lloyds, the Italian line, the Inman line, the Hamburg line, the Bordeaux line, the State line, the Red Star line, the French line, the Monarch line and the Amsterdam line — after considering the interesting statement with which you had favored the meeting the representatives of the lines present, being desirous of adopting such measures as will insure protection against the introduction and propagation of contagious and infectious diseases, especially small-pox, it was

"*Resolved* : — That we will co-operate with the National and State health authorities in carrying out to the best of our ability such recommendations to effect this purpose as they may advise.

"The meeting was favorably impressed with the propriety and feasibility of the following measures, namely : —

"1. That intending passengers should be inspected and certified before departure.

"2. That all passengers should be vaccinated on board, within twenty-four hours after leaving port; and

"3. That all suspicious cases should be strictly isolated on the passage.

THOMAS S. SANDFORD, *Secretary*."

The action of the managers which followed this communication was speedily evident in the increased vigilance of the officers of steamships and the marked diminution of small-pox among immigrants arriving at this port.

During the first seven months of the present year — which allows thirty days for the organization of the effort of steamship managers after

date of their communication — thirty-four vessels entered the port with small-pox. Since that time — nearly five months — but five cases have been detected. The number of vessels on which the disease occurred corresponds to the number of cases.

Protection of the life and health of the people of the United States, which is paramount to all other considerations, is now seriously jeopardized by the introduction through immigrants of this loathsome disease in its latent condition. If owners and managers of passenger lines will earnestly co-operate with the health authorities at our maritime quarantines, through the measures indicated, they will contribute greatly to arrest the introduction and propagation of a disease that now annually numbers more human victims than any and all forms of disease subject to quarantine.

It is proper to remind the owners and managers of those lines that suitable hospital accommodation for the isolation of the sick of contagious diseases is greatly neglected on many vessels. The continuance of this neglect will expose many immigrants to infection, and in case of contagious disease on board will subject the vessel to delay at quarantine and the line to expense, which might be avoided.

WILLIAM M. SMITH,
Health Officer port of New York.

It has long been a recognized fact, that infectious and contagious diseases at certain intervals, not regular, well defined, or always dependent on known causes, assume epidemic proportions in many localities in the same country, and in widely separated countries. In some forms of disease this is doubtless owing to certain thermometric, hygrometric and unsanitary conditions which favor the propagation of the germs of disease when introduced.

In small-pox, another factor than these, or the inherent law of the disease, must be taken into consideration.

During the period of rest, new material accumulates, through births, immigration, changes in the population, or renewed susceptibility to the disease. During these intervals in the development of the disease, protection by vaccination is scarcely thought of, much less attended to by the public; the authorities are silent and unconcerned while an advancing generation provides "fresh fields and pastures new" for a high revel of the disease.

Chapter 438, laws of 1860, which authorizes "the trustees of the several common school districts in the State, and the proper local boards of common school government in the several cities of the State, to exclude from the benefits of the common schools therein any child or person who has not been vaccinated, and until such time when said child or person shall become vaccinated," remained inoperative, practically a dead letter, for many years; and until the State Board of Health during the past year, through its present indefatigable secretary, brought it prominently to the attention of the people.

When the receptive soil which has accumulated through many changes, and which has been fertilized by many years of neglect, has been exhausted by the ravages of the disease, or by the vaccinator who is suddenly stimulated into activity by the development of accidentally scattered germs of the disease, and the fears of the people, the epidemic

ceases, and the disease disappears for years from communities where it has prevailed.

The Board of Health of New York city affirm that no case of small-pox originated in that city from January, 1878, until the fall of the succeeding year, embracing a period of nearly two years. There is no disease of an infectious or contagious character which is so cultivated by the ignorance and neglect of the people as small-pox; while there is none in which prophylactic treatment is more certain. In view of these *facts*, the indifference and prejudice of the people, of local Boards of Health, and even of legislative bodies, in the absence of immediate danger from the disease, is a matter of great surprise to all intelligent sanitarians.

The opponents of vaccination have failed to give a single reason for their opposition that should weigh against the fact which daily experience repeats, that vaccination properly effected secures perfect immunity from small-pox — not always for all time, though in many individuals it affords protection for a life-time. But by the early vaccination of all persons, and the revaccination after the expiration of eight or ten years, it is not too much to say that this disease may be banished from the list that afflict mankind.

The opposition, and sometimes decided refusal of immigrants arriving at quarantine to be vaccinated after known exposure to the infection of small-pox, have afforded satisfactory evidence that coercive measures of the most decided character will be necessary to secure that result.

In some instances where compulsory vaccination has been resorted to among immigrants arriving at New York, the vaccinated have resorted to washing, and even the employment of fellow passengers to suck the vaccination wounds to remove the vaccina. This prejudice against vaccination exists among immigrants of several nationalities — particularly among the Irish and English; created in considerable degree, it is believed, by the pernicious influence and teachings of anti-vaccination societies. The principal objection made by the anti-vaccinationists being the danger of transmitting to the vaccinated the constitutional or acquired diseases of the person from whom the virus is taken, is obviated by the use of carefully selected *bovine virus*. It has been estimated that not one case in 100,000 of vaccinations has been attended by unpleasant results. Abrasions or wounds of no greater severity than those necessary in vaccination, without the introduction of any infectious principle, would be likely to result as frequently in some unpleasant consequences from exposure to accidental causes.

The records of the Vaccine Department of the New York City Board of Health show that in the seven years previous to the 1st of January, 1882, 101,420 primary vaccinations and 343,708 revaccinations, were made without result prejudicial to life or health, which were justly chargeable to the vaccine influence.

The practical conclusions to be drawn from experience in the administration of the New York quarantine, so far as relates to prevention of the introduction of yellow fever and small-pox, may be briefly summarized.

In yellow fever, the immediate removal of sick to hospital, the detention of the passengers and crew until the usual incubative period has elapsed, reckoning from the last exposure at the infected port; the discharge of cargo, and cleaning and disinfection of the vessel insures pro-

tection. And if the history of the vessel during the voyage warrants the belief that it is infected, such of the passengers and crew as are not protected by climatic exposure or previous attacks of the disease, should be removed to quarantine of observation or detained on board the vessel until the time for development has passed.

In small-pox, the long period of incubation, and the conditions under which it now generally appears at our maritime quarantines, require the quarantinist to go beyond his own jurisdiction and arrest the contagion at the port of departure.

1. By securing an efficient sanitary supervision and police of lodging-houses and other places of resort for immigrants at the port of said embarkation.

2. The medical inspection of all immigrants by the physician of the steamship, within twenty-four hours after they go aboard, and the vaccination or revaccination of all persons not sufficiently protected by previous vaccination.

3. The certificating of such as are protected, by a card bearing the word "protected" or "vaccinated" and the signature of the medical officer

4. The re-examination just previous to entering the port of arrival, of all that have been vaccinated on board ship, and the issue of such certificates to the successfully vaccinated.

If this system could be carried into successful operation, it would be the "ounce of prevention" that would render unnecessary the "pound of cure." It would crush out at the initial point the infection that cannot be eliminated by any reasonably restrictive measures at the port of destination, while the present tide of immigration is deluging the country.

It is well understood that no law of the State or of the National government bearing upon the action of steamship passenger lines, will be recognized as having any binding force in foreign ports, or on vessels under foreign flags in transit to ports in the United States. Hence the necessity of imposing such restrictive measures at our ports of entry, through State and National legislation, as will secure the active coöperation of owners and managers of passenger steamships. This, it is believed, will be effected by the adoption and vigorous execution of the following measures:

1. The examination and vaccination at quarantine of all immigrants not having a certificate of protection.

2. The detention of all unprotected persons who have been exposed to the contagion of small-pox, until the protective influence of vaccination is obtained, or until the incubative period of the disease has elapsed.

3. The removal to the quarantine of observation of all persons refusing to be vaccinated, and their detention fourteen days from last exposure.

4. The verification under oath by the medical officer of the vessel, that his duties in the examinations and vaccinations referred to have been faithfully discharged.

There is good reason to believe that the execution of these measures at the port of New York would result in the most earnest and vigorous measures on the part of owners and managers of passenger lines at the port of embarkation.

The following minutes illustrate the spirit in which an appeal to these parties was received. Their coöperation in the plan proposed, to the extent of their ability, is not doubtful.

Minutes of a Meeting of the Representatives of Trans-Atlantic Passenger Steamship Lines, convened at the request of Dr. William M. Smith, Health Officer of the port of New York, at No. 19 Broadway, N. Y., on Wednesday, June 29, 1881, at 10 o'clock, A. M.

Present — Dr. William M. Smith, and representatives of the following lines, namely:

The Cunard Line,	The Hamburg Line,	The French Line,
The Guion Line,	The North German Lloyd,	The Monarch Line,
The Inman Line,	The Red Star Line,	The Bordeaux Line,
The State Line,	The Rotterdam Line,	The Amsterdam Line,
	The White Star Line, The Italian Line.	

Dr. Smith stated that he had sought this meeting in order to secure, if possible, the coöperation of the several lines in preventing the introduction of contagious and infectious diseases, especially small-pox, and thus avert action by the National Board of Health which was urged by State and local Boards throughout the country, in consequence of the general prevalence of small-pox among newly landed immigrants.

That in May, 1880, foreseeing the probable extension of the disease, I proposed plans to guard against it, which did not then attract much attention, but the demand for restrictive measures is now very great, especially in the West.

At a convention held in Chicago on June 23d, 1881, action was taken, looking to the intervention of the National Board of Health, which caused me to think that the steamship lines should be advised to take such steps as would preclude the necessity for such intervention.

The National Board of Health has power to adopt rules which, when signed by the President, become law, and it is urged that a rule be adopted requiring all vessels to be quarantined for fourteen days from the time of the first exposure to small-pox; that is, if a case should manifest itself on the voyage when three days out, and the passage be made in eleven days, the ship must remain in quarantine for six days.

As the adoption of such a rule would seriously injure your interests, I have considered how it may be avoided.

The average passage by steamer is short compared with the period of incubation of the disease; passages being ordinarily made in from eight to eleven days, whereas the period of incubation is fourteen days; but, fortunately, vaccination operates more quickly yet, and may be depended upon to neutralize the disease if resorted to in time.

It has been my practice, when satisfied that the ship's surgeon has strictly isolated all cases on the passage, to pass the vessel without insisting upon the vaccination of the passengers, and I have done this to stimulate the vigilance of surgeons, but I have nevertheless discovered, in many cases, great negligence in this particular.

I think that if you will adopt the following measures, namely:

1. That intending passengers shall be inspected and their physical condition certificated, before embarking.

2. That all passengers shall be vaccinated on board, within twenty-four hours after leaving port; and

3. That all cases that may develop on the voyage shall be strictly isolated.

And will assure me that you will enforce them to the best of your ability, I can satisfy the National Board of Health that it is not necessary to adopt the proposed rule requiring your vessels to be quarantined.

The thanks of the meeting were tendered to Dr. Smith for his courtesy and consideration.

Dr. Smith then withdrew.

The meeting then organized, Mr. William H. Guion in the chair.

After considering the statement made by Dr. Smith, the secretary was instructed to address him an official assurance of the disposition of the several lines to coöperate with the National and State Health authorities in carrying out to the best of their ability such measures as said authorities may recommend to prevent the introduction of contagious and infectious diseases, especially small-pox. And it was agreed that printed copies of the proceedings of this meeting be sent to the home offices of the several lines, with a recommendation that the measures proposed by Dr. Smith be carried out as far as practicable.

Adjourned.

The number of passenger steamships on which small-pox has been found on entering the port of New York, since the conference referred to (June 29, 1881), has been but one-fourth the number for the corresponding period immediately previous to that time.

Few immigrants will reach our quarantines with developed small-pox, and a less number will pass them with latent contagion, if the execution of these measures can be secured at, or near the port of departure. The examination of the immigrants *at quarantine*, the protection of the unprotected, and their detention until satisfactory results are secured, will not only protect the public, but will stimulate the exertions of those interested in immigrant transportation, to a degree scarcely less than the passage of laws of the same character by the government or local authorities at the port of departure.

Subsequent to the adoption of the "revised and additional rules," by the National Board of Health, and their approval by the president, a conference between the managers of passenger steamship lines, and the health officer of the port of New York, was convened, January 9, 1882, at the request of that officer, at the office of the "Trans-Atlantic Passenger Steamship Association," to consider how the "rules and regulations" referred to may be executed most effectually, and with the least embarrassment to the interests of the steamship companies, it was decided to recommend the home officers of the several lines to adopt the following protective measures, namely:

First—That agents throughout Europe be instructed to inform intending passengers that, unless they are vaccinated before leaving home, they will be subject to vaccination on the journey or to detention at quarantine for fourteen days after arrival.

Second—To endeavor to secure the vaccination by the authorities or by medical officers employed by the companies at the port of departure of such passengers as may have neglected previous protection.

Third—To require the vaccination on board within twenty-four hours after leaving port of such passengers as may have escaped or refused the foregoing opportunities.

Fourth—To provide hospital accommodation on board absolutely isolated from the quarters occupied by the passengers or crew.

Fifth — To instruct the medical officer of the ship to furnish each passenger sufficiently protected by previous vaccination a card on which shall be written or printed "Protected," and signed by such medical officer; as all passengers not having such a certificate will be considered and treated as exposed or unprotected.

The following are the companies represented:

Inman Steamship Company (Limited), by John G. Dale, agent; Oelrichs & Co., agents of North German Lloyd, Bremen; F. W. J. Hurst, manager National Steamship Company; R. J. Cortis, agent, White Star Line; Austin, Baldwin & Co., agents State Steamship Company; Red Star Line, Peter Wright & Sons, general agents, by George W. Colton manager, New York; for Louis de Bebian, agent, Aug. d'Orville; Patton, Vickers & Co., agents Monarch Line; Vernon H. Brown & Co., agents Cunard Line; Kunhardt & Co., agents Hamburg-American Packet Company; H. Cazaux, general agent Rotterdam Line; Liverpool and Great Western Steamship Company (limited), Williams & Guion, agents; Anchor Line, Henderson Brothers, agents.

In none of the contagious or infectious diseases subject to supervision at our ports are the relations of quarantine officials and municipal Boards of Health so mutually dependent, to prevent their introduction among interior communities, as in small-pox. Inspection at some local point by State or local authorities of the migration moving along the great thoroughfares, and observation and supervision for a few days, of that portion of it which disperses along the way, and a careful inspection under the direction of the National Board of Health, of all immigrants arriving at distributing points, such as Buffalo, Suspension Bridge, Pittsburg and Port Huron, as a measure of inter-State quarantine is essential to safety. And when the people of the several States, either through the National government, or in their independent sovereign capacity, shall be so far advanced in their appreciation of the efforts of intelligent and philanthropic sanitarians, as to enable them to secure a compulsory law for vaccination of all unprotected persons, the most loathsome, most fatal, most frequent, and yet most preventable of the diseases which now afflict the human family, will be one of the most infrequent of those that now number their victims annually by thousands.

The work of the quarantinist who watches for "the pestilence that walketh in darkness," at the gateways from the sea to our great cities, is intimately related to that of local health officers. The disease-producing germs, latent or otherwise, that escape the former, find no lodgement in the presence of the latter. The filth and waste that follow in the footsteps of men in the busy marts of commerce, and the crowded tenements of the poor, in the absence of intelligent sanitary work and in the presence of conditions that impair the vigor, and lower the vitality of human beings, become a fertile field for the propagation and cultivation of infectious and contagious germs, until, from sporadic cases, the proportions of an extensive and fatal epidemic is reached.

The humbler classes may suffer first, and most; but the forces of disease when recruited in the slums of streets, and crowd poisoned air of filthy lodging and tenement houses, extend to the homes of culture and refinement, victimizing alike in these ranks the valued and valueless, the worthy and the unworthy.

Respectfully submitted,

WM. M. SMITH, M. D.,

Chairman of Standing Committee on Quarantine.

TYPHUS FEVER.

As the true typhus, or ship fever, had for almost twenty years so nearly disappeared from the city of New York as to warrant the hope that it might not again become prevalent, the reappearance of it in the cities of New York and Philadelphia during a time of unusual prosperity and in the presence of a surplus of food, is chronicled in the following abstract of records of the present experience. This old enemy of neglected and impoverished crowds in great cities and unventilated lodgings has lost none of its traditional contagiousness.

ELISHA HARRIS, *Secretary.*

AN ACCOUNT OF TYPHUS FEVER AS IT APPEARED IN THE CITY OF NEW YORK, DURING THE YEAR 1881, BY E. H. JANES, M. D., ASSISTANT SANITARY SUPERINTENDENT, ETC.

To Secretary of the State Board of Health:

On or about the first day of September, 1880, a young woman, twenty-three years of age, living in a tenement house on Avenue C, and working in a collar factory on the east side of the city, was taken sick with what was believed by her physician to be typhoid fever, from which she began to convalesce the fourth week, and finally recovered.

On the 24th of the same month, the mother, aged fifty-eight years; a sister, aged twenty-seven; another sister, aged twenty, and a brother, aged twenty-eight, were all reported to the Board of Health as sick with "typhoid" fever and were therefore removed to Riverside hospital. The apparent contagiousness of these cases, with certain symptoms appearing which are not ordinarily seen in *typhoid* fever, arrested the attention of the resident physician, and upon consultation with the Health Commissioners, and a careful examination of the cases, it was found that the symptoms were those of typhus fever. This diagnosis was further confirmed by the subsequent illness of the nurse who took care of the Brady family, and who in due time was attacked with true typhus. Her's was a typical case, and for some time her recovery seemed doubtful. About the same time or a little later, a case of "typhoid" fever was reported in a tenement house in West 27th street. The premises, as is the usual practice in such cases, were visited by a sanitary inspector, who found the hygienic condition to be very bad. No examination was made of the patient and the diagnosis was accepted, as well as that of one or two other cases which occurred in the same house, the impression being that the sickness was due to local causes. Some days later it was learned that the first of these patients had worked beside one of the Brady girls in the collar factory.

How many cases of the fever may have preceded those of the Brady family, or how many may have immediately followed them unrecognized, is not known, for the next case on record is a death at St. Francis hospital, which occurred on the 21st of February, 1881.

On the 14th of March there were admitted to Riverside hospital, from Charity hospital, four cases, two of which had come from the "Shiloh Shelter," a lodging house, No. 57 Prince street. On the 15th two cases were admitted from Bellevue, both having been lodgers at "Shiloh." On the 16th six cases were admitted from Charity, seven from Bellevue, and three from the German hospital. Of these, three had come from "Shiloh.' On the 17th ten cases were admitted from various sources, including the three hospitals above mentioned, three of whom had lodged for some time in "Shiloh," and two were from the house in West 27th street where the earlier cases, supposed to have been typhoid, but now, from their relation to the Brady family, believed to have been typhus, had occurred.

On the eighteenth six cases were received, four of whom were from "Shiloh." During the week ending March nineteenth there were reported to the Board of Health and received at Riverside hospital forty cases of typhus fever from hospitals and from their homes, of which number fourteen were from "Shiloh." After this there was a partial abatement for two weeks as follows: week ending March twenty-sixth, seven cases; week ending April second, ten cases. The number now increased to forty-one during the week ending April ninth; to sixty during the week ending April sixteenth, which was the largest number reported during any one week. From this time the number gradually diminished, though varying from week to week until week ending August twenty-second, during which one case was found at Charity hospital and removed to Riverside. On the twenty-fourth of September one case was reported from the Ninety-ninth street hospital by the coroner's autopsy. No other cases occurred until November first, when six boys, ages varying from nine to thirteen, were sent from St. Joseph's Home, number fifty-three Warren street, to Randall's Island, supposed to be suffering with typhoid fever. On the twenty-second of November four other boys were sent from the Home to Randall's Island as typhoid, all of which were subsequently diagnosed as typhus. During the next three days sixteen boys, aged from six to twelve, were sent from the Home to the Riverside, and on the first of December James Daly, aged 42, a teacher in St. Joseph's Home, was reported sick with typhus at St. Vincent's hospital and removed to Riverside where he died, the autopsy confirming the diagnosis as well as settling any doubts that may have existed in regard to the boys, in all of whom the disease was of a mild type. December sixth, four boys were removed from the home, after which no other cases occurred in the institution.

During the year five hundred and six cases of typhus were treated at Riverside hospital, received from different parts of the city, many of them from crowded lodging houses, and of that class of men known as tramps having no homes and lodging wherever they can find shelter. Among the lodging houses, "Shiloh" contributed by far the largest number, being twenty-nine in all. Fourteen were from the lodging house number 61 Thompson street; eight from 112 Green street; five from number 80 Wooster street, five from number 10 James street, four

from number 152 Chatham street, and three from the tenement house in West Twenty-seventh street, indicating that the contagion had persistently adhered to the house through the winter months, notwithstanding fumigation and disinfection.

The above are only a few of the lodging and tenement houses which contributed from one to three or four or even more cases each during the season, many of the patients having been in the habit of going from one lodging house to another forming a net work of contagion which made the grouping of cases extremely difficult.

The diagnosis in all the cases was based on the prominent symptoms of typhus, as the cerebral symptoms, the dullness of the intellect, the peculiar expression of the countenance, the characteristic eruption with elevation of temperature. These symptoms with the evidence of contagion were present in all of the cases.

As is usual in typhus, the lesions were neither uniform nor strongly marked, save, perhaps, enlargement and softening of the spleen which was generally present, with a dark, and fluid appearance of the blood. The following lesions were also found in most of the cases: The pia mater at the base of the brain showed opaque, white lines, which were also noticed on the pia mater of the ventricles. The pia mater of the cervical region had a slightly dull look. Lungs œdematous and somewhat congested in lower lobes. Kidneys and mucous membrane of the stomachs and small intestines more or less congested. Liver fatty.

This unexpected advent of typhus found the city health department not fully prepared to meet the emergency, as nearly all of the hospital accommodations were occupied in the care of small-pox, and such other contagious diseases as were refused admission to other hospitals. The only means at command for the reception and care of typhus patients were hospital tents, which were obtained and placed in position on the grounds of Riverside hospital, Blackwell's Island, with as little delay as possible. Thus in a short time there was ample room, and although the weather was severe during the month of March and the early part of April, the tents were made comfortable and the patients generally did well, the proportion of recoveries being very fair, as will presently be seen.

With a view to the early suppression of this outbreak, a special corps of inspectors was organized, whose duty it was to make frequent visits to all lodging houses in the city for the purpose of enforcing a better system of cleanliness and ventilation, and of detecting any new cases of fever. Many of these visits were made at night, at which time every lodger was carefully examined; and by this course many cases in the incipient stage of the disease were found and at once removed to the hospital for treatment. The question of closing some of the more crowded lodging houses was very carefully considered by the health department, but as there was full reason to believe that such a course would have the effect to scatter the lodgers throughout the city and establish new centers of disease, it was wisely determined not to interfere any farther than to induce the proprietors to refuse all new applications, thus each house keeping its regular lodgers and admitting no others, the system of nightly inspections was facilitated, and the disease more readily brought under control.

In addition to these frequent inspections at night, daily inspections

were also continued, and two or three times a week the houses where fever had occurred were fumigated with sulphur. Tenement houses in which the disease was found were all subjected to a like daily supervision. On his arrival at the hospital the patient's clothing was removed from him and destroyed, it in many instances being extremely filthy and "alive with vermin." Hospital clothing was furnished during the term of sickness, and when the time came for the patient's discharge a new suit throughout was furnished, at the expense of the health department whenever the patient's circumstances were such that he had no friends, or was unable to supply himself. *It was an invariable rule not to allow typhus clothing to find its way back to the city.* This careful watching of every place where the fever appeared, the early discovery and separation of the sick from the well, the frequent disinfection and fumigation of apartments, the enforcing of more thorough cleansing, and ventilation, with the immediate destruction of infected clothing, are believed to have been the successful means of arresting the progress of a disease which at one time threatened to become a pestilence to our city. Doubtless the determination of the health department not to break up crowded lodging houses where the fever existed, notwithstanding frequent petitions from citizens and property owners in the vicinity of such places, did much to prevent the disease from spreading more extensively throughout the city. Acting on this view of the subject, and fully believing in the importance of early discovering every case, and that this could be done only by daily and nightly visits, the department took no aggressive steps towards the evacuation of any lodging house until some weeks after the last case had been removed.

The total rate of morality during the season was twenty-four and fifty-one one-hundredths per cent, a ratio quite satisfactory when it is remembered that a large number of the patients were broken down by alcoholism, exposure, or semi-starvation.

The following table has been carefully prepared by Doctor Chapin, and will be examined with interest.

Riverside Hospital—Typhus Fever, 1881.

AGES.	ADMITTED.				DIED.				Ratio of deaths to admissions for each decade.
	No.	Per cent.	Males.	Females.	No.	Per cent of total deaths.	Males.	Females.	
Five years and under	3	0.60	1	2	....	....	....	....	....
Five to ten	19	3.75	16	3	....	....	....	....	....
Ten to twenty	50	9.88	42	8	4	3.22	4	....	8.00 per cent.
Twenty to thirty	147	29.05	124	23	22	17 74	17	5	14.97 per cent.
Thirty to forty	147	29.05	125	22	41	33.07	33	8	27.89 per cent.
Forty to fifty	79	15.61	68	11	24	19.36	20	4	30.38 per cent.
Fifty to sixty	38	7.51	34	4	19	15.32	17	2	50.00 per cent.
Sixty to seventy	20	3.95	19	1	11	8.87	10	1	55.00 per cent.
Seventy to eighty	3	0.60	3	....	3	2.42	3	....	100.00 per cent.
Total	506	100.00	432	74	124	100 00	104	20	24 51.

By examining the above table it will be seen that of the twenty-two admissions of patients under ten years of age, there were no deaths; of those admitted from ten to twenty, eight per cent died, while for each following decade the death rate increased.

Among the nurses and attendants at the hospital, two nurses, six orderlies, and four female helpers took the fever, of which one orderly and one helper died. Only one orderly and two helpers escaped, and of the latter one was said to have had the disease during a previous epidemic. The others who where exposed were the matron who was daily among the sick, often doing the duties of nurse, and the nurse who later in the year had charge of the children from St. Joseph's Home. Both of these escaped the fever. Whenever an attendant was taken sick, there was generally a recovered patient ready to fill the vacancy and thus new exposures were avoided. The physicians in attendance, although feeling for a few days indisposed, with an elevation of temperature, both escaped the fever. The faithfulness of physicians and nurses in their devotion to the sick was unremitting both night and day, and cannot be too highly commended.

In regard to the original causes of this outbreak, there is a lack of positive information, especially if we are to look upon typhus as an exotic depending for its development on importation. It was thought by some to have been brought from Camden, N. J., where there had been a number of cases, but investigation failed to establish the entire truth of this statement. The fact that one or two tramps passed through Camden on their way to the city of New York, where they arrived about the time the fever broke out, does not prove that they brought the fever with them.

If we look upon typhus as a filth disease, developed *de novo* amidst filth and poverty, we may look to the condition of some of the lodging houses for a possible solution of the question. It will be remembered that the winter of 1880–1881 was one of unusual severity. Tramps from all parts of the country flocked to the city for food and shelter, which they can always obtain, the former by begging from door to door, the latter at the five and ten cent lodging houses. In this way the cheap lodgings and police stations were crowded as they had rarely or never been crowded before, while the cold nights found all of the windows securely closed, thus shutting out every breeze of fresh air from the apartments, leaving the sleepers to rebreathe for hours the same atmosphere, which constantly became more and more contaminated from busy lungs and filthy bodies. As there were no beds in these cheap lodging houses, except raised platforms of plain boards, the lodgers never undressed, but wore the same clothing, night and day, week after week, until it became saturated with animal exhalations. Some of the patients were so dirty that it was not until after a good washing that a diagnosis could be established by the eruption. Living for an entire winter under such influences, if not sufficient to develop typhus, is certainly favorable to its propagation.

EDWARD H. JANES, M. D.

REPORT OF THE COMMITTEE ON DRAINAGE, SEWERAGE AND TOPOGRAPHY.

This committee reports progress in the duties that have been assigned to it by submitting the more important papers that have been referred by the Board during the year, accompanying the same with a brief account of the results of investigation relating to the subject to which they refer.

The committee has to call attention to the fact, which appears in nearly all the petitions and papers that have been referred for investigation, that the State has not yet enacted any general drainage law adapted to the common necessities of the communities and districts which suffer most from neglect and obstruction of drainage; and that there is found to be no adequate provision of law to prevent the pollution of streams and other sources of drinking water. Few, if any, of the numerous petitions and complaints which have been referred by the Board to this committee, and less than one-half of the cases that have been presented by appeal of the inhabitants, to the Governor, and by his direction referred to the Board, are found to be susceptible of correct sanitary and engineering treatment, under what is known as the General Drainage Act of 1869, and the amendments of that act.

The natural topography of the State of New York has determined its normal drainage areas, and these are not difficult to understand with reference to the essential questions which relate to sanitary drainage. But the committee has to notice in numerous instances that the immediate occasion for a complaint and appeal to the State Board, with regard to the drainage or improper outflow of sewage into sluggish streams or ponds, lakes, etc., requires a more comprehensive treatment of the primary questions of drainage and sewerage than a single village or neighborhood will separately undertake to give in such matters. The jurisdiction of village, or even of town authorities, must not unfrequently be largely transcended in the study and preparation of really *adequate* plans for the drainage or sewerage that is required for the protection of the public health. For this reason the committee unhesitatingly calls the attention of the Board to the importance of vesting in some suitable source of correct judgment a wise and useful discretionary authority for approval, at least in regard to plans for sanitary and economic drainage as demanded for the protection of life and health under the various circumstances in which the immediate local authority cannot, or will not, devise and put into action all the necessary plans for securing the sanitary interests of a community. Perhaps no better illustration of this

can be presented from the list of cases that have been referred to this committee than that which was found to be of general importance in the village of Croton Falls, a hamlet which had not sufficient population to obtain incorporation. The four townships contribute a corner of their contiguous territory, respectively, within the limits of the village area which requires systematic drainage to render life and health reasonably secure. Not one of these four towns could consistently undertake, through its Health Board or otherwise, to devise plans and provide for the execution of the work by which the drainage and the outflow of that little village shall be sanitarily and economically satisfactory and sufficient. It was found by Engineer Croes, who accompanied a member of this committee on the inspection, that each of the four townships shared to some extent in the responsibility for the sources of nuisance and danger, which should be at once prevented by the adoption of a simple system of ground drainage and safe outflow from dwellings, to fields or streams, at a suitable distance from their doors.

The Croton river bisects the village and offers facilities for the defilement of its waters. There is no settlement of the question of sanitary duty as regards the village and the Croton river, without first determining upon, and adopting a suitable plan for the village drainage, and its outflow of excrement and waste. A like necessity for the adoption of a suitable general system or plan of drainage, etc., for an area that comprises parts of contiguous townships, will be noticed in the papers, herewith submitted, relating to drainage along the line of the abandoned canals in Schuyler, Chemung and Livingston counties.

To meet numerous calls of duty this committee has from time to time been permitted by the Board to engage temporarily the services of expert civil engineers who have acceptably met the exigencies which have arisen in the Board's service in this respect. We would refer particularly to a few papers that are submitted to illustrate the extent of the work which the Board has undertaken. Among the most important questions now before this committee and the Board itself are; —

1. What should be recommended as the best plan for a separate and most economical system of sewerage for villages and small cities; and by what methods shall the outflow of storm-water and the soil-drainage of such places be secured?

2. In what manner shall the ground-drainage of building-sites be thoroughly secured for separate dwellings and ordinary villages?

3. What provisions are required in a general drainage law that shall be applicable and most useful throughout the State, and which shall treat natural drainage areas in the most effectual and economical way, yet mainly at the expense of towns and estate owners, without involving such works in the discredit and vexation of county bonds?

4. What other, if any, of preliminary work relating to sanitary drainage, should the State bear; and what judgment and responsibility may justly be regarded as proper to require of the State Board of Health with respect to determining the necessity of, and plans for, each project of general drainage?

These are practical questions, sure to be thrust upon the attention of the State Board and of the local Boards of Health from time to time. As every drainage project, and every scheme for storing or reserving extensive bodies of water will ever involve important sanitary consideration, this committee respectfully submits the question, "Ought not the

State Board of Health to secure the preparation of a suitable project of law to meet the question here mentioned; and ought not the State to direct that its engineer and surveyor and its Board of Health shall not only examine and approve, but counsel and aid in regard to proposed drainage works under a general drainage law?"

This committee finds the most important questions which were referred to it by the Board have a wider scope, and that the study of them, has a more general importance than has usually been implied in the reasons given by the local authorities and citizens who have applied to the Board for advice on these subjects. For example, the nuisances caused by stagnant pools and malarial grounds that are accused of bringing half the population under medical treatment for miasmatic sickness, are precisely like those which many a little hamlet, many an owner of mills and shops, and many a farmer even lets exist, to the great harm of families and working people who are exposed to these results of sheer neglect and ignorance. In other words, the questions and petitions which a local Board of Health, or a larger number of citizens in a village or city, send up for the consideration of the State Board or the Governor of the State, are in a smaller, but not less important, way the very questions that have to be asked, and the very petitions or demands that ought to be made, in every neighborhood where local causes of diseases are produced and neglected. This committee believes it to be the duty of every local Board of Health to make such faithful and timely sanitary inspections and maintain such a habit of correct general and special observations, of the local and domiciliary causes of fatal sickness, that there shall be throughout the State a wise oversight and repression of all the causes of the malarial and filth diseases. If adequate sewerage and safe house plumbing must be provided in cities, then surely in the village and rural towns there should be no reeking ditches and pools of excremental filth, and no ventilation of cesspools into the dwellings which they endanger, nor should cottages and rural homes be permitted to have about them any preventable sources of foul air and disease poisons. Even the watering places and summer retreats, to which a vast proportion of the city and village population resort, must be protected as never yet they have been by law and correct sanitary practice for the prevention of diseases from their filthy outflowing and their miasmatic environment. The committee in concluding this brief report submits a large variety of special papers and statements which amply ilustrate the importance of the several points here presented.

Respectfully submitted,
For the Committee,
E. HARRIS, *Secretary.*

Abandoned Canal Nuisance and Miasmatic Disease in Chemung and Schuyler Counties between Horseheads and Havana.

The Chemung canal, extending from Watkins to Elmira, was abandoned in 1878. Its 45 locks and levels, between Havana and Horseheads, soon became the seat of obstructed pools, and, as shown in this Board's first report, the physicians in that region unanimously accused this nuisance as the cause of unusual sickness along the abandoned canal.

The first drainage work extended to lock 45, 4 1-2 miles north of the village of Horseheads. The long level extending from lock 45 to Horseheads village remained a nuisance, which cannot be completely abated as long as that village maintains the dams that the legislature of 1880 authorized (chapter 379, of 1880) for giving that village an artificial pond. The dam across the canal in the village, as authorized by that law, completely obstructs the outflow from the long level, though a natural creek, which should have its drainage southward into the Chemung river.

An abstract of petitions and medical testimony relating to the evils we are about to describe in this account of sanitary work along the line of the late abandoned canal, extending southward from the head of Seneca lake, was presented in the report of this Board a year ago. It was shown conclusively that a large proportion of the families in the immediate vicinity of the abandoned canal, had suffered grievously from miasmatic fevers and other disorders, and as these maladies reappeared, and were much complained of during the month of May of the present year, the President and Secretary as members of this committee made a tour of inspection on the 30th of May, and reported to the Governor the results with the following statements.

To His Excellency, A. B. Cornell:

The undersigned, a committee of the State Board of Health, appointed to report on the nuisances alleged to have been caused by the abandonment of the Chemung canal, would respectfully report:

That they have made personal inspection of the places complained of, and taken the testimony of physicians who have care of the people in the neighborhood. The amount of sickness is appalling, no family escaping the invasion of malarial diseases, for a distance of two miles along the borders of the old canal, even children at breast becoming purple and shaking in the cold stage of intermittent. We find the prism of the abandoned canal has become a marsh. But we believe the whole danger can be removed by simply ditching, with a little filling at special points. We advise if such work is undertaken, that the ditches be so protected at the sides as to become durable.

(Signed) E. M. MOORE, *President.*
ELISHA HARRIS, *Secretary.*

Thereupon, the Governor transmitted this brief communication to the legislature with the following request:

The attention of the legislature is respectfully, but earnestly, called to the importance of providing for the prompt abatement of a nuisance emanating from the present condition of the abandoned Chemung

canal, and dangerous to the health and lives of people living in the immediate vicinity.

Thé report of the State Board of Health, to whom the complaint of citizens was referred for investigation, is herewith transmitted, from which it will be seen that great suffering is now felt in consequence of the neglect of the State to provide suitable protection against the evils complained of.

It is hereby recommended, therefore, that the Superintendent of Public Works, be authorized to take the necessary steps to remedy the existing difficulty, and suitable appropriation be made for that purpose.

(Signed) ALONZO B. CORNELL.

Dated *June* 1, 1881.

Acting upon this information and request, a sufficient appropriation was made.

Before the Governor had signed that act which had passed both branches of the legislature, the appeals for advice from that portion of the country bordering upon the abandoned canal, between Mount Morris and Dansville in Livingston county, received attention from members of this committee, under direction of the Board, and upon reporting back to the Governor the results of inspection in that region, the enactment here mentioned was returned to the legislature, and by it amended, and passed, becoming chapter 593.

The superintendent of public works proceeded early in July to execute as much work as practicable before the 10th of August, a period at which it was deemed expedient to terminate such drainage work for the time being. During that brief period of less than six weeks, thirty-nine levels of the Chemung branch of abandoned canals were drained. A description of the drainage work is presented in the report made by Hon. Dr. G. M. Beard, here submitted on a subsequent page.

Abandoned canal nuisance. Late Genesee Valley canal, between Dansville and Scottsville.

An appeal by the local Board of Health of Groveland, Livingston county, here annexed, was supported by such medical testimony that it became neccssary for the State Board to report to the Governor, the results of an examination which he directed to be made. The following is the petition:

To the State Board of Health:

The undersigned, the Board of Health of the town of Groveland, county of Livingston, State of New York, would respectfully represent:

That the condition of the Genesee Valley canal since its abandonment by the State, and especially at the present time, is causing a great amount of sickness in said town of Groveland, in the vicinity of the canals. The recent rains have made pools of standing water in the prism of the canals, which there is no possible means of draining off by the adjoining owners, or by the town Board. This stagnant water has become very offensive, and the probability is that if some steps are not taken at once to remove the nuisance, malarial fever, and other kindred diseases which have already become very prevalent in the vicinity of the canal, will there become a pestilence.

We therefore respectfully ask that some steps may be at once taken

by your honorable Board to avert such a calamity, by providing some means of draining such stagnant water from the canal.

Dated GROVELAND, N. Y., *May* 27, 1881.

(Signed) JOHN W. SICKLAY,
" R. J. KELLEY,
" WM. W. WISE,
" EDWARD W. MANN,
" RICHARD JOHNSON.

The report on behalf of the Board's committee and by authority of the Board to the Governor, is as follows:—

To Hon. A. B. CORNELL, *Governor:*

SIR:—The undersigned members of the State Board of Health, being the committee appointed by the Board to examine and report upon the sanitary requirements of certain portions of the abandoned canals, respectfully report that the complaint and petition of the Board of Health is found by us to be fully sustained by the facts in the case, as learned by the personal inspection of one of us. We find that from the village of Mount Morris southward for a distance of seven miles and upwards, within the towns of Groveland and Mount Morris, the bed or prism of the canal has become an artificial swamp, due to want of drainage and to various obstructions, such as the deposit of earth by storm-floods, the breaking down of banks, the construction of crossings, etc., and in a few places the diverting of natural water-courses in connection with canal construction and the defense thereof in former years. The faulty construction of crossings has not, until recently, been prevented, but the evils thus caused can be speedily remedied by the town authorities. Yet if so remedied, as they soon may be by local authorities, the greater portion of the bed of the canal, for miles in extent, would still be in the condition of a miasmatic swamp which will be dangerous to health and life until it shall have been thoroughly ditched and drained, and until certain streams are prevented from overflowing into and choking the bed of said canal.

We find the existing swampy bed of said canal is a nuisance dangerous to life and detrimental to health to a large number of inhabitants in its vicinity. We also find that the Board of Health of the town of Groveland has correctly represented that neither the owners of the adjacent property, nor the Town Boards of Health can suitably drain and protect said abandoned canal, so that it shall cease to be a nuisance; therefore, we respectfully recommend that whatever and in whomsoever vested the ownership and holding of the said bed and premises of the canal in the towns of Groveland, West Sparta, Nunda and Mount Morris, may be, the responsibility for abating and preventing the nuisances herein described shall be fixed and the official orders be served and enforced for abating and preventing said nuisance.

We further report that there are certain natural water-courses, and probably one or two artificial changes in old waterways that will need to be controlled and protected from contributing to the nuisances in and about said canal, and that as all said works for such control and prevention of evil from said water-courses need to be executed by authority of the State and at its expense, it seems expedient that a sufficient sum be provided by the State for said purpose.

So urgent is the work required in Groveland section of the Genesee Valley canal that we respectfully recommend that the persons and parties who own or hold the said canal should be immediately notified of the action required by the State for the abatement and prevention of the nuisance as herein described.

E. M. MOORE, *President.*
ELISHA HARRIS, *Secretary.*

The Superintendent of Public Works proceeded to execute such drainage works as were found to be permitted under the conditions that existed at the end of July when the workmen commenced. Dr. Ames, of Mount Morris, consented to represent the State Board in its sanitary advice, and from day to day, concerning the sections which should be drained with safety during the month of August with reference to the greatest relief from the sources of malaria suffered in regions between Dansville and Mount Morris.

The following preliminary report by Emil Kuichling, C. E., made under direction of the State Board, and the report of Dr. Ames which follows, explain all that needs to be presented in this place.

Preliminary Statement with reference to the Drainage of the Dansville Branch of the Abandoned Genesee Valley Canal in Livingston County.

By Emil Kuichling, C. E., Rochester.

Rochester, N. Y., *July* 22, 1881.

Dr. E. M. Moore, *President of the State Board of Health*,

Dear Sir: On the 14th inst., the undersigned received from your Board instructions to proceed, on Friday morning, July 16th, to the village of Mt. Morris, Livingston county, N. Y., and to make, in company with Dr. L. J. Ames and Mr. Wm. Napier, Assistant Superintendent of Public Works, an examination of the sanitary condition of the abandoned Genesee Valley canal in Livingston county, and determine upon methods for removing from said canal such stagnant water as might be found.

In accordance with the instructions received, the undersigned would herewith submit the following preliminary report:

Upon my arrival at Mt. Morris at 10:30 a. m., on Friday, July 16th, I found Dr. Ames awaiting me at Mr. Miller's store, and learned from him that Mr. Napier had reported to him earlier and then departed for Geneseo in order to attend a lawsuit in which his presence as a witness was imperatively necessary. Inquiry by telegraph elicited a reply that Mr. Napier would be at liberty to return to Mt. Morris at about 3 o'clock that afternoon, and therefore it was decided to await his arrival before going over the line of the canal. In the meantime Dr. Ames and the undersigned called upon Mr. T. Gamble, Supervisor of Mt. Morris, Dr. Joslyn, local Health Officer, and Mr. C. J. Perry, clerk of the local Board of Health, for the purpose of obtaining a statement of the general sanitary condition of said township and of any nuisances caused

by the construction and abandonment of the canal. It may here be mentioned that no complaints concerning the village and its immediate vicinity were offered, owing to the effective measures that had already been taken by the local authorities of said village to remove any stagnant water in the bed of the abandoned canal.

Immediately after his arrival from Geneseo, Mr. Napier, Dr. Ames, Dr. Joslyn and the undersigned proceeded over the line of the canal from Mt. Morris to Dansville. The general course of this section is south-easterly, and, for the greater portion of the distance, winds horizontally along the hill-sides at a comparatively small elevation above the general level of the alluvial lands of the valley, the towing path being almost entirely an embankment.

A large amount of surface drainage from the hills is intercepted directly by the canal; and hence many of the natural water courses which originally traversed the lands on the northern and eastern side of the canal, became dry and have gradually been obliterated by the action of the elements, and also by processes of agriculture. It therefore becomes evident that if the canal were to be drained by means of cuts through the towing path embankment, great care should be taken to locate such cuttings at points where suitable water courses or drainage ditches are conveniently at hand. There are, however, upon this section of the canal, a number of culverts, waste-weirs, spillways and aqueducts, all of which can be utilized in the removal of any water that may find its way into the abandoned channel, and accordingly cuttings through the tow-path bank will be required only in a few instances.

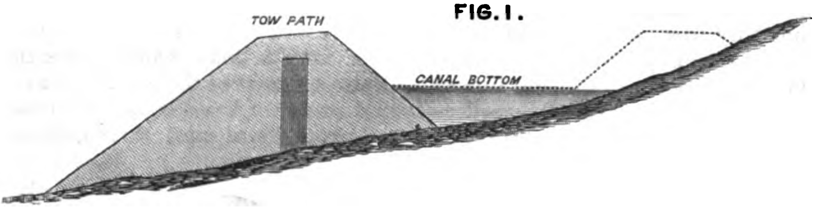
The general plan herewith recommended by the undersigned for disposing effectually, and at the same time very economically of the water which now collects and becomes stagnant in this portion of the canal, may briefly be stated as follows:

To thoroughly break up, by plowing, the thin and relatively impervious layer of accumulated silt, or the lining of clay or argillaceous earth which was originally deposited upon the canal bottom wherever necessary for rendering it water-tight; and then, by means of horse-scrapers, to remove the loosened impervious material to the banks or sides or to any convenient depressions or hollows. A shallow trench about three (3) feet wide can thus be rapidly formed in the bed of the canal and access obtained to the porous strata below, into which large quantities of water will readily pass by simple absorption. But to render the work of drainage still more effectual, it is recommended that the above described trenches be cut with a slight, but uniform grade, from a point or summit about midway between two consecutive places of discharge, for which natural water-courses of suitable magnitude should be chosen. These latter may always be reached by opening a culvert, or by lowering the abutments and breast-walls of aqueducts and spillways; or, when unavoidable, by direct cuts through the towing path embankment. It will thus be seen that by the plan indicated in the foregoing, large volumes of storm water will be conveyed to natural and open water-courses, while small quantities of rain or melted snow will be disposed of quickly by being absorbed into the permeable earth exposed by the trenches.

In a few instances, pools or small ponds of more or less depth are found in the canal bottom, especially upon the estate of the late

Dr. Fitzhugh. These pools are formed by the construction of the tow-path embankment across a gully or small ravine whose bed was origi-

FIG. 1.

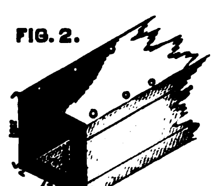


nally below the bottom of the canal, as indicated in Fig. 1, but which was not filled up during the construction of the canal in order to save expense. The dotted lines in the diagram indicate the work of embankment that would have been required in order to make the channel of uniform section throughout. Several such pools are in close proximity, and if the dividing ridges separating them are not too high, the group may be connected by a communicating trench, and then emptied through a single cut made in the tow-path bank. Where, however, the pools are too far apart to be economically connected, each must be provided with a drainage sluice, and the water conducted into some convenient water-course or land ditch.

Gullies or ravines of this description convey frequently large quantities of storm water which can not be permitted to flow unrestricted over cultivated fields that have been formed over the former water courses in the low lands beyond the canal; and even where land drainage ditches are found in natural depressions, such ditches are not of suitable size to receive, without overflowing, the discharge of these gullies. In these cases, and also in all places where the towing path embankment is designed to be converted into a public highway, and cuts through the banks are necessary, it is recommended that wooden outlet sluices be inserted into and through said bank at sufficient depth to remove all of the water; and that such sluices be of small cross-sectional area, both to gain the scouring action of the water for maintaining them open, and also that a relatively long period of time shall elapse before the pond becomes empty. Should more water arrive at such a sluice than it is capable of discharging the pond or pool will fill up, and the surplus water then finds a ready escape through the trenches in the canal bottom towards some large water course; and after the storm has ceased, the small sluice will continue to perform its duty until the pool is dry.

The undersigned is of the opinion that these sluices will be most economical, and also very durable when made of sound white oak plank, 2 in. or 2 1-2 in. thick, well spiked together and giving a clear

FIG. 2.

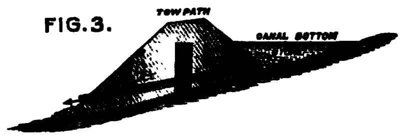


opening of about 7 in. or 8 in. square, as shown in Fig. 2 Such sluices

are quickly constructed and put in place; and when properly spiked together, they are tight and adapted to conveying water under pressure, besides being flexible enough to yield without injury to slight displacement by frost or settlement.

To check and regulate the discharge into a small water-course or land-ditch from one of the sluices, and also to prevent the earthen bank at the inlet from being washed away, a quantity of loose stone, or brush and stone, should be deposited over and around said inlet at the bottom

FIG. 3.



of the canal or gully, as indicated in Fig. 3. It is better to use the loose stone freely, as the water will then become partially filtered before reaching the sluice, and thus render the latter less likely to become choked up by silt or rubbish.

Having thus stated the general methods recommended to be pursued in the drainage of the Dansville branch of the abandoned Genesee Valley canal, the undersigned will now submit a list of the several items of work to be performed by Mr. Napier, beginning at the Kishaqua aqueduct, at the juncture of the said Dansville branch with the main line of the canal, and extending for the present to the first lock south of the Canaseraga aqueduct:

1 The south abutment of Kishaqua aqueduct to be lowered.

2. Open culvert designated as structure No. 45.

3. Form and grade trench in bottom between first and second.

4. Drain two contiguous pools, on Fitzhugh estate, by sluice through bank and grade in both directions.

5. Open culvert, on Petrie farm, designated structure No. 42.

6. Drain two adjacent pools, either by trench back to fifth, or else by connecting same and by sluice through bank.

7. Drain the series of four pools, on Fitzhugh estate, by connecting same and then by sluice through bank into ditch.

8. Open culvert designated structure No. 40, and grade in both directions.

9. Lower breast wall of spillway, designated structure No. 39, at Keyserville, and grade in both directions.

10. Cut through bank and drain into ditch dividing lands of Mr. Wadsworth and E. McMaster, and then grade in both directions.

11. Cut through bank between tenth and Rock Spring aqueduct, and grade in both directions.

12. Lower abutments of Rock Spring aqueduct and grade.

13. Lower abutments of aqueduct designated structure No. 36.

14. Lower breast wall of spillway, designated structure No. 29, and grade in both directions. This is on Chas. W. McNair's estate.

15. Cut through tow path bank between last-named point and the first lock following, and grade in both directions.

16. Lower abutments of aqueduct on Bradner's farm, and grade in both directions.

17. Lower abutments of Canaseraga aqueduct, and grade in both di-

rections, particularly to lock at Cumminsville, designated as structure No. 11, at the foot of which a spring arises.

Between the lock at Cumminsville and the village of Dansville, considerable ditching is necessary for the purpose of carrying away the discharge or overflow of a large spring, which appears in the cellar of the "Allen House" in Dansville, and flows through the abandoned basin and slip into the canal, where it becomes stagnant in the shallow pools caused at the foot of several locks by the scour of the water in the operation of the canal. From information obtained from a number of prominent citizens of Dansville, it would appear that the ownership of the aforesaid slip and basin is in dispute; and hence Mr. Napier expressed himself as not being justified, without specific instructions from Supt. Dutcher, in expending any portion of the appropriation in ditching for the long distance from Dansville to Cumminsville only to dispose of the water overflowing from a private spring. This matter would seem to belong rather to the health authorities of Dansville, and accordingly their attention was officially directed to the question by Dr. Ames.

In respect to the general condition of the canal on this section, from a sanitary point of view, the undersigned would say that only in a few places did it appear as particularly unhealthy, and that any danger might be incurred in carrying out the method of drainage proposed and recommended in the foregoing. More unsalubrious places occur on the line of the main canal between Mount Morris and Kishaqua aqueduct than on the Dansville branch. The former section, however, is in the possession of the Genesee Valley Canal Railroad Company, and neither Mr. Napier nor the undersigned felt authorized to request the officers of said company to commence the work of drainage.

As Mr. Napier could not give more than one day's time to the examination of the canal in Livingston county, the undersigned returned on the following day, after receiving assurance that work on the Dansville branch would speedily be commenced and prosecuted; and a note from Mr. Napier informs me that he intends to begin operations on Monday, July 25th. After a few days required for the proper organization of the work, or about the following Friday, July 29th, he will be ready to accompany Dr. Ames and the undersigned over the line of the canal in the towns of Leicester and York, in said county.

In regard to the approximate cost of the work submitted above, the undersigned is of the opinion that the amount appropriated ($1,000), for the drainage of the Dansville branch, will, if judiciously expended, be more than sufficient; and Mr. Napier hopes to be able to leave a handsome balance for expenditure in other localities.

Respectfully submitted,

EMIL KUICHLING, *Civil Engineer.*

To the State Board of Health of New York:

As your local agent I would respectfully report in respect to the drainage of the Dansville branch of the abandoned Genesee Valley canal.

The work was delayed until the month of August last, when, under the direction of Mr. William Napier, in behalf of the Department of Public Works, it was begun.

That portion of the above described canal beginning at the junction

with the main canal at the Shaker settlement, in the town of Groveland, south-eastward to about one mile north of the village of Dansville, has been about three-fourths of the distance completed, to the full requirement of sanitary conditions.

The bed of the canal and the standing pools have been well and sufficiently drained by ditching and opening sluices for the water to pass into the former and natural water-courses.

The portions passed over and left undone, north of Cumminsville, have been thus omitted because of objections to the work by the owners of lands through which the canal passed.

These omissions will work injustice and injury to other land-owners who have willingly allowed the openings to the natural water-courses with the expectation and understanding that *all* such water-courses were to be opened, so that no undue surplus water should be allowed to flow upon them.

This is a matter that should be adjusted by some legal steps, so it seems to me.

The work done has removed from the bed of the canal several miles of stagnant surface water and leaves it as dry as the adjacent tillable lands, — which must be a great sanitary gain.

There is now about one mile, beginning at Dansville northwards, that it has been impracticable to drain at present, on account of the work of the removal of the stone from the locks, but should be done before the heat of another summer.

But a very important work remains to be done upon the main line of this canal, which the State has sold to a railroad company.

Nothing has been done in the matter of drainage by such company (and I verily believe nothing will be done by it only as it is compelled by the stern force of the law).

I have examined this canal in company with Mr. E. Kuichling, of Rochester, your civil engineer, from Scottsville, in Monroe county, to the junction near the Shakers, in the town of Groveland, in Livingston county. The extent of water and points of drainage needed, have been clearly pointed out in Mr. Kuichling's report.

I have substantially examined the canal-bed further south from the Shakers to Portage; a portion of it with the health officer of the town of Mount Morris. A large percentage of the whole distance contains water, and is of course malarious in its condition and results.

The owners of this canal-bed should be required to do this work to the satisfaction of the State Board of Health, and also to that of the local Boards of Health through whose towns it extends, and maintain and keep it in a sanitary condition.

This can only be done but by ditching, and opening into the old water-courses, as indicated in Mr. Kuichling's report, so that no standing water shall be allowed to accumulate in any portion of this canal which said railroad company controls.

I transmit herewith the action taken by town Boards of Leicester and Mount Morris.

The chief engineer of this railroad company was notified by me of the action of the town Board of Health of Leicester, but of course nothing was done.

Respectfully,

L. J. AMES.

MOUNT MORRIS, N. Y., *October 3d*, 1881.

It will be seen that the objections made by certain real estate owners to complete the drainage work on the Dansville branch of the abandoned canal bed were not overcome by the local authorities, and that some drainage work remains to be completed, when the necessary assent is obtained, or to be required as soon as the local transfer of such property has been made to the citizens, whose estate is contiguous to the late canal.

REPORTS AND ACTION RELATING TO MIASMATIC SECTIONS OF THE ABANDONED CANAL, NOW OWNED BY THE RAILROAD CORPORATION.

There seems to be no doubt that so long as the Genesee Valley canal continued to be used as a navigable waterway, it facilitated rather than impaired the sanitary drainage of the Genesee and Canaseraga valleys, and it is still more certain that its abandoned prism, by obstructions to, and other effects upon the natural water-courses, has resulted in a serious increase, or intensifying effect, of miasmatic conditions in a great number of places The annexed statements which have been made to this Board by the local Boards of Health of Mount Morris, Leicester and York, and the annexed report by Emil Kuichling, C. E., show ample cause for the final report which this committee made to the Governor by authority of the State Board.

I, F M. Joslyn, clerk of the Board of Health of the town of Mt. Morris, Livingston county, N. Y., do hereby certify that the following is a true copy of a resolution adopted by the Board of Health, in and of the town of Mt. Morris, at a meeting thereof, held September 27, 1881· "Resolved that the whole abandoned Genesee Valley canal, situate within the limits of the town of Mt. Morris is, and is hereby declared by this Board to be a nuisance."

F. M. JOSLYN,
Clerk of the town Board of Health.

MT. MORRIS, N. Y., *Oct.* 1, 1881.

Dr. AMES, *of Mt. Morris, N. Y.:*

Sir.—The undersigned, composing the Board of Health of the town af Leicester, would respectfully submit that they have examined the bed or prism of the Genesee Valley canal (so called), from the Genesee river (the town line south), to the town of York, and find more or less stagnant and bad smelling water along the whole line, but would especially call your attention to that portion at "Tracey's basin," now known in this section as "Wooster's basin." At this point from the peculiar lay of the land west of the basin which descends to, and makes said basin the receptacle of water which does not find any outlet, and therefore, especially at this season of the year, makes filthy, stagnant and bad smelling water, which is detrimental and dangerous to the health and lives of those living in close proximity, and also to a greater or less extent to the whole town.

We would also call your attention to two or three dams or bars which have been put across the canal at points north of said basin. The dams obstructing the natural flow of the water in the prism of the canal make it stagnant and filthy.

The Board would respectfully urge such remedy of these evils as may lie in your power with the promise of coöperation on our part.

Respectfully,

DORIES THOMPSON, *Supervisor*.

J. S. WHEELOCK,
JOHN WHEELER,
G. W. LANE,
Justices of the Peace.

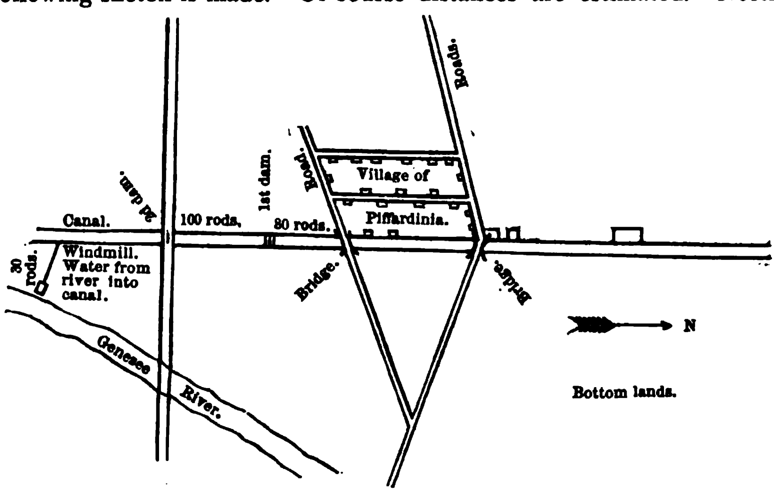
F. H. MOYER,
A. M. WOOSTER, M. D.,
Health Officer.

YORK, LIVINGSTON COUNTY, N. Y.,
June 30, 1881.

To the State Board of Health:

SIRS: — In your reply to a petition of the citizens of Piffard, in the town of York, you requested to have said reply presented to the supervisor of the town, which reply was duly received by me as supervisor. You therein requested that the town Board of Health convene and act as provided by the law for organizing boards, etc., and to have a chart and description of pools of stagnant water sent to State Board.

Previous to the receipt of your letter we had organized a town Board of Health and had looked the ground over, and from that inspection the following sketch is made. Of course distances are estimated. North



of the village of Piffard to the north line of this town (York) there is as yet no complaint of malaria.

At Piffard there seems to be a considerable deposit of sediment and water at the north end of the village, near Kendall's saw-mill, with water through the village in small detached puddles, which at that time seemed to be rapidly drying up. From the canal bridge at the south end of the village to dam placed across the canal by the owner of adjacent lands, about 80 rods, the canal was dry, no water to be seen. Above the dam the water appeared about 2 feet deep. He had there pierced the heel-path with an iron pipe through which was running a 2-inch stream. On the tow-path side there was also a like discharge into watering troughs. This reservoir set back about 100 rods to where the

canal has been filled in for a highway bridge. The upper reservoir is supplied with a force-pump at the river, distant about 30 rods, driven by a turbine wind mill.

We learn from a resident director of the Genesee Valley Canal Railroad that the Railroad Co. will aid in work directed by the State Board of Health.

(Signed) A. D. NEWTON, *Supervisor.*

With this testimony and a complete report, in detail, upon the engineering facts in the proposed drainage, the Board made its report to the Governor.

The Governor's action upon the report thus submitted by the Board is shown in the following order:

COPY.

To the President and Directors of the Genesee Valley Canal Railroad Company, and others whom it may concern:

Complaint having been made to me of the condition of the abandoned Genesee Valley canal, its banks and prism, which has come into your possession and ownership for railroad purposes, as affecting injuriously the public health, and as dangerous to life; which said complaint having been duly referred to the State Board of Health for examination· and the said State Board of Health having fully inquired into the facts, and made report thereon, declaring, among other things, "that they find the late Genesee Valley canal at various places between Scottsville, in the county of Monroe, and Kishaqua creek, or the Shakers, so-called, in the county of Livingston, is a nuisance; and that it should be speedily well drained, so that it shall cease to be a source of miasmatic disease." Now, therefore, in accordance with the statutes in such case made and provided, and the authority conferred by chapter 322, sec. 8, of the laws of 1880, the matters and things found and certified by the State Board of Health, as to the condition of the abandoned Genesee Valley canal — its banks and prism — are hereby declared to be a public nuisance; and the same is hereby ordered to be changed, abated or removed by the Genesee Valley Canal Railroad Company, its president and directors, as herein more specifically set forth, to wit: That the said abandoned canal be drained for the distance of twenty-nine miles, lying between Scottsville, in the county of Monroe, and Sonyea or Kishaqua creek, at the aqueduct by the Shakers, in the town of Groveland, county of Livingston, as marked in the schedule of the canal levels herein described, viz.:

TABLE SHOWING RELATIVE LENGTHS OF GENESEE VALLEY CANAL CONTAINING STAGNANT WATER BETWEEN SCOTTSVILLE AND SONYEA.

Section.	Total length—miles.	Length containing water, miles.	Length comparatively dry, miles.	Remarks.
From lock No. 3 to lock No. 4	8.64	7.40	1.24	Scottsville to Canawaugus.
From lock No. 4 to lock No. 5	2.10	0.10	2.00	Canawaugus to Sackett's Basin.
From lock No. 5 to lock No. 6	5.10	3.00	2.10	Sackett's Basin, south.
From lock No. 6 to lock No. 7	8.16	3.16	5 00	Piffardinia and Clayville level.
From lock No. 7 to lock No. 8	1.00	1.00	0.00	Genesee river, north.
From Mt Morris to Sonyea	4.00	3.00	1.00	Genesee river to Kishaqua creek.
Total	29.00	17.66	11.34	Miles.

That such drainage be so made as to remove and hereafter prevent the accumulation of water or silt where found constantly covering the bottom of the canal prism, and that such drainage be made in the most feasible and practicable manner possible, according to the condition of the case in the locality to be drained. And it is further ordered that the natural streams, valleys, and ravines near to or crossing the said abandoned canal be so kept clean of obstructions at and within the abandoned canal limit as not to produce stagnant ponds or silt to the detriment of the public health, all of which drainage and other work attendant upon the removal of matters and things complained of, to be made and done before the first day of April 1882.

In all and singular respects as to which work for the removal or abatement of the nuisance hereinbefore referred to, the State Board of Health, and Superintendent of the Public Works, will, where practicable, co-operate.

[L. S.] (Signed,) A. B. CORNELL, *Governor.*

Dated, *Nov. 1st,* 1881.

The Governor's order as quoted was served upon the president of Genesee Valley Canal Railway, on the 3d of November, and it is said by the attorney of the railroad company that the order will be complied with in good faith.

A malarial region on the Hudson river-front of the town of Cortland.

Members of the family of the late Col. C. have since the 16th of November until the end of the year 1880 and onward continued to urge that general sanitary measures should be adopted for the prevention of miasmatic diseases from which they were suffering in the immediate vicinity of Oscawana Island, and which, by the families chiefly concerned, are attributed to the stagnant ponds that separate this island from the main land which in later years, since the filling of the embankments of the Hudson River Railroad, have been cut off from all "tidal scour" of the Hudson river.

Formal petitions by numerous inhabitants have been filed during the spring of 1881 asking for the advice and direction of the State Board of Health concerning this matter; the Secretary inspected it during the month of May, and having obtained the services of engineer J. J. R. Croes, that gentleman made a report of which the following is an abstract:

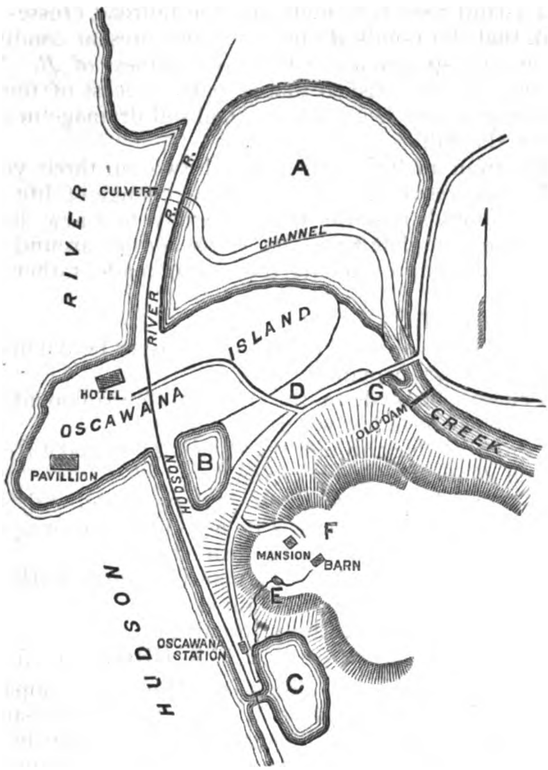
ENGINEER CROES' REPORT.

NEW YORK, *June* 13, 1881.

To the State Board of Health:

Under your instructions I visited Oscawana Island and Cortland station on the Hudson river, in Westchester county, on the 11th inst., and examined the alleged sources of malarial disease, and conversed with the principal families in that region.

The accompanying sketch, which is not made to scale, no map being at hand, gives a general idea of the localities.



The pond A is for the most part above low water mark, and except in the channel, presents at low tides a large expanse of mud flats.

The pond B is closed to the river, and is fed by surface drainage from the high lands on each side. There is probably a slight percolation through the railroad embankment, one way or another according to the relative height of the pond and the river.

The slough D was once evidently an open channel. It has been silted up for many years; there is a thick growth of under brush and small trees in it, but it is now a bog of black muck full of standing pools of water.

The hillside from B and D, toward F, rises very steeply and is thickly wooded, as is also the slope from F toward C. The space around and in the rear of the mansion on top of the hill is cleared.

South of the mansion and near the barn, several springs appear which form a stream. On this little stream, at E, there is a small pool, the bottom of which is a bed of black decomposing vegetable matter.

Near F, in the rear of the mansion, there is every indication of a pocket in the rock, creating a saturated subsoil.

C is a pond formed by the railroad embankment across a small bay Part of the area is bare at low tides.

At *G*, where a causeway has obstructed the streams partially, there is a cove bare at low water, and with a black muck bottom.

Oscawana Island rises very high, and the railroad crosses it by a tunnel. I think that the ponds *A* and *C* in their present condition are unhealthy. I am not so sure about the unhealthiness of *B*. The slough *D* is unhealthy. I am satisfied that a part at least of the malaria at the C. mansion proceeds from defective subsoil drainage near the house, and on top of the hill.

The trouble from malaria, experienced two or three years ago on Oscawana Island, resulted from the total change of life and habits, caused by the family's removal from the city to a new house in the country, with the complete *upturning of the old soil* around the place in the progress of the improvements then being made, rather than by the ponds *A* and *B*.

I would recommend:

1. That the culverts from *A* and *C* to the river be dammed to about two feet above low-water mark.
2. That a culvert be made in the railroad embankment at *B*, with its bottom two feet above low water.
3. That a ditch be dug through the slough *D*, to make free communication between *B* and the creek channel.
4. That the cove *G*, be filled above high tide level with sand.
5. That the low ground around *A* be not cultivated or upturned.
6. That the stream and pool *E* be cleaned out.
7. That the ground around the C. mansion, particularly the hollows to the east and south-east, be underdrained.

Respectfully submitted,

J. J. R. CROES, *Civil Engineer.*

June 26, 1881, Commissioners Brooks and Harris, in company with the town Board of Health of Cortlandt, inspected the nuisances in the vicinity of Oscawana Island, with engineer Croes' report in hand. All points and recommendations in the engineer's report, were concured in by a majority of the local Board, with one point excepted for the present, namely; that instead of draining the slough towards the creek, it seemed to be preferable to drain the southern half at least, into what is known as the "fresh water pond;" as soon as that pond shall have been culverted to receive the "tidal scour" of the Hudson. The proprietors upon whose lands and premises these improvements are required, were present. Though an opinion had been expressed that the so-called "fresh water pond" ought not to be connected with the Hudson, yet, until within a few years past, it was merely an elbow or bay — there remains no doubt that the culvert and "tidal scour" should be provided for. It is not a fresh water pond, but a slimy pool. The northern half of the slough will in all probability be successfully drained, into the creek, that makes its way to the Hudson through Mr. De G.'s property. The latter gentleman promised the officers of the local Board of Health, while upon the premises on this inspection, to carry out in full all the recommendations made in the engineer's report. All his lowland property, comprising some thirty acres, is upon the northern and western margin of the slough and creek.

Miasmatic Nuisances at Croton Falls.

Upon the petition of numerous citizens of Croton Falls, confirmed by a sanitary map prepared by physicians of the village, this committee

visited Croton Falls, attended by a civil engineer, who made the following report, illustrated by a map here appended marked "F.," and diagrams "ff."

NEW YORK, *June 13th*, 1881.

Dr. ELISHA HARRIS, *Secretary State Board of Health :*

SIR : — I have the honor to submit herewith a sketch of the village of Croton Falls, in the town of North Salem, Westchester county, with the location of the several probable causes of diseases indicated thereon by figures and explanatory notes, as examined in company with you on the 4th inst.

The nuisances may be classed under these heads :

1. Those which tend to pollute the Croton river, including Nos. 2, 5, 6, 7, 8, privies which are either directly over the water or on the sloping bank without vaults, and No. 9, a slaughter-house, which discharges its refuse into the stream.

2. Those which are offensive to the smell and pollute the atmosphere, without directly affecting water supply. These are Nos. 3 and 10, slaughter-houses not properly cared for.

3. Those which unquestionably affect the ground and water of adjacent wells, and poison the air and the water. These are Nos. 4, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, and possibly 26.

4. Those which produce malarial vapors from soil saturation. Nos. 11 and 12 ; the hollow on the east side of the Harlem railroad embankment is of this class.

The nuisances of the first class appear to me to be offenses against the general health, and ought to be abated at once by the removal of privies and slaughter-houses from the bank of the river, or any point where their contents can reach the stream.

The nuisances of the second class can be abated by a very little attention to cleanliness and a removal of refuse, under the direction of the local authorities.

The nuisances of the third class are of the most serious character, as affecting the health of nearly every house in the village. It is hardly possible that the water of any of the wells examined can be fit to drink.

It is difficult to suggest a complete remedy for these evils without more thorough examination and consultation with the people, than has yet been. A general outline of what should be done may be given as follows :

a. Extend the present partial system of water supply from remote springs to as many houses as possible.

b. Thoroughly cleanse and disinfect all privy vaults.

c. Remove all privy vaults to at least fifty feet from wells, and place none on ground higher than the wells.

d. Compel the frequent cleansing of all such vaults, and the covering of their contents with clean dry earth, frequently while in use.

e. For the two blocks of houses east of the railroad, on high ground, a pipe sewer might be laid to remove all slops, etc., entirely, to the meadow land south of the village, there to be disposed of by irrigation.

f. Thorough ventilation of cellars.

The fourth class of nuisance is found only in one locality and is produced by the railroad embankment. A tile drain should be laid on the line and grade designated on the accompanying sketch, No. 2, and a slight ditch made as shown, for about 250 feet, at the foot of the bank,

to carry surface water of storms to the culverts. Care should be taken to see that this ditch is always kept unobstructed.

All of the above work can be done inexpensively and under the direction of an intelligent health officer; except, that if any sewerage is undertaken, the advice of a competent engineer should be obtained and followed.

Respectfully, your obedient servant,

J. J. R. CROES, *C. E.*

A copy of this report was presented to the supervisor and medical gentlemen of North Salem, and a conference was held with the physicians who were in attendance from each four towns whose contiguous corners comprise the hamlet of Croton Falls. The authorities in each of the towns concerned were advised to organize their respective town Boards of Health.

A miasmatic stench nuisance in New Rochelle, Westchester Co.

The following petition, signed by Albert Smith, M. D., William Askew, Charles Higbee, John Dillon, and nearly one hundred others, to Governor Cornell was referred by him to this Board, June 8, 1881:

"*To his Excellency* ALONZO B. CORNELL,

Governor of the State of New York:—

The undersigned, residents of the village of New Rochelle in the county of Westchester, and State of New York, respectfully present the following for your consideration:

That a great public nuisance exists in the aforesaid village, caused by refuse and waste material being allowed to run from the New Rochelle Brewery into a stream of water known as "Burling brook," which has its head waters near the center of the village, and thence runs nearly a mile through the village until it empties into the waters of Long Island Sound, causing vile and pestilential odors to fill the atmosphere for a long distance on each side of the stream, and causing much sickness and malarial diseases.

And your petitioners verily believe that the said nuisance should be abated at once, in order to preserve the health and lives of the inhabitants of this village.

Your petitioners, therefore, pray that the State Board of Health may be required to examine into the facts set forth above, and that such steps may be taken as to the same as are provided in and by chapter 322 of the laws of 1880.

All of which is respectfully submitted."

To this was appended the following memorandum, signed by Drs. Wells, Pryer, and Huntington, well-known physicians.

"The undersigned, practicing physicians of New Rochelle, hereby certify that we believe the condition of the brook referred to in the foregoing petition to be a nuisance detrimental to the health of the community."

After careful inspections, the report hereto annexed (marked C) from J. J. R. Croes, C. E., was made. Thereupon the committee reported its conclusions to the Governor in the following terms:

"The committee finds it a duty to report to your excellency that the nuisance as herein described and consisting of the outflowing matter from the said brewery, its stables and appurtenances, should be abated and wholly prevented so that it shall not in any manner pollute the at-

mosphere in the village and vicinity of New Rochelle, and that in whatever manner and to whatever place the said outflowing of waste matter shall be conveyed, or made to flow, to tide water, or elsewhere, it shall be so conducted that it shall not endanger the health of the inhabitants on shore."

["C"]

NEW YORK, *Nov.* 28, 1881.

To the State Board of Health, N. Y.:

Under your instructions I visited New Rochelle, on the 18th inst., and examined the disposal of the washings of the wash-tubs and yeast casks and floors of Jones' brewery. The waste water which is very offensive and contains the decomposing refuse is carried by a drain to three tanks 12 x 14 feet, and after partial settling, flows into the brook which runs through the lands of several owners for about 8150 feet, emptying into a small bay of Long Island Sound at Pelham post office. The refuse causes bad odors all along the bank and then is deposited on the mud flats along the bay which are bare at low tide. The accompanying diagram shows the position of the brewery, and the tanks, and the course of the refuse.

Respectfully, your obedient servant,
(*Signed,*) J. J. R. CROES.

Inspection of a water-side hotel and summer resort, by a sanitary engineer and the committee.

June 28th, the president of the Board of Health of New Brighton sent the following telegram: "Please, will the State Board of Health supply a sanitary engineer and inspector, to make an examination of the ——— hotel. Diphtheria has broken out." To this the following reply: "I will call on you and the Health Officer, at the residence of the latter with a sanitary engineer, at 9:30 A. M., July 2."

(Signed) E. HARRIS.

At the appointed hour, the Secretary of the Board accompanied by Mr. T. J. Nealis, sanitary engineer of the Health Department, New York city, met the president and Health Officer of New Brighton, and proceeded to make a careful inspection of the hotel. The details of the inspection were duly recorded by the local Board of Health. It resulted in the following orders, made before leaving the premises the evening of July 2, after the formal statement by the sanitary engineer, of what would be required in each particular.

"Upon results of inspection by the local Board of Health of New Brighton, and sanitary engineer Thomas J. Nealis, and the Secretary of the State Board of Health.

Resolved— That the proprietor of the ——— Hotel be directed to carry out the following precautions and repairs which are reported to this Board as essential for the protection of health:

1. To empty, disinfect and cleanse the receiving-vault in the basement at the head of main sewer, and the pipes discharging therein.

2. To remove all obstructions from sewers.

3. To ventilate receiving-vault by a six-inch pipe, carried above the highest point of the roof.

4. To have the flag stone over the receiving-vault laid in cement.

5. To provide a trapped-sink in place of the open slop grating which discharges into receiving-vault.

6. To have the servants' water-closets in basement either wholly renewed, or placed and kept in proper sanitary condition. To disinfect and remove all filth from ground under seats.

7. To thoroughly disinfect and cleanse and ventilate basement, removing the flooring and soaked woodwork around water closets.

8. To place stench traps in waste-pipes directly under all untrapped fixtures, and to have all slip-joints made tight.

9. To have ice boxes disconnected from sewers and made to discharge into trapped safes.

10. To have all openings from surface of basement into sewers effectually closed.

11. To effectually repair sewer from ice-house and trap it so that no gas can escape into house.

12. To continue the soil pipe in each wing, at its full calibre, up to not less than two feet above the roof.

The execution of the work was commenced at eleven P. M., the same evening, July 2nd, and resumed at four A. M. Monday following, continuing until the entire work was satisfactory. The proprietor has expressed to the Secretary of the State Board his approval and thanks, though the language of the order was peremptory. At the date of inscribing this record, we add by authority of the health officer of New Brighton, that the sanitary improvements here described became the certain means of exterminating and preventing causes of sickness which threatened to depopulate, and keep depopulated, this great establishment which has contained from three to five hundred persons from June till late in October. The proprietor of his own part has undertaken to carry out still more extensive improvements in view of the results that have followed these orders of the Board of Health. He has assured the Secretary of the State Board, that the employment of a competent sanitary engineer at the time of his inspection was, in his judgment, of the highest importance.

Special Reports on Systematic Drainage of Extensive Swamps that contribute their Water to the Erie Canal.

Note.— The correspondence of the State Board of Health and the advice required by local authorities in the towns and villages that are situated in the vicinity of extensive swamps, have proved to this Board that it is a duty to begin systematic inquiry and labors which shall result in securing the sanitary drainage that the inhabitants of separate towns and villages cannot of themselves alone secure.

The Board invited to its assistance in beginning its inquiry in this field, Mr. Emil Kuichling, a civil engineer, whose special familiarity with certain swamp areas in Western New York, and whose professional ability would insure the proper commencement of needed investigations and systematic efforts in a region where the rights of the State to take and control the waters of the great swamps are well known. The great swampy basins or watersheds of the Tonawanda and Oak Orchard creeks which comprise portions of Erie, Niagara and Genesee counties, offered the first field for inquiry. Engineer Kuichling's preliminary statements are now presented without any technical details; as the health and future welfare of a vast population will be largely dependent upon suitable drainage of the swampy regions he has begun to describe,

this paper is submitted to the public as a kind of information much needed. Other malarial swamp regions are sure to be examined by local as well as the State authorities, and the true significance and share which swamps and water-soaked regions have in the natural history of miasmatic diseases and the failures in prosperity or progress become correctly understood.

Salubrious and opulent as this State is, there is a vast quantity of malarial swamp that should be reclaimed from its present *injurious* condition, even if the prospective values of such drained areas did not promise — as, fortunately, they do — to repay the full cost for such improvement.

In the geological survey of the State, Prof. Mather found there are about 125 square miles of salt marsh regarded mostly as reclaimable. Extending our inquiry inland, we find that the interior and western counties have extensive marshes and swamps which are far more damaging to the public health than any of the tidal marshes can be; and at the same time the value of reclaimed swamps like those of Genesee and Niagara counties vastly exceeds that of drained salt marshes. In alluding to the paramount importance of sanitary drainage in the inland regions, we would invite attention to the extent of these miasmatic areas. The swamps of Orange and Ulster counties amount to nearly 25,000 acres; the drowned lands of Orange amounting to about 15,000, and nearly all being capable of complete reclamation as rich fields that might be kept free from malaria when drained. The swamps in Madison and Oneida counties comprise nearly 22,000 acres, including the swamps around and west of Oneida lake. The Cayuga and Montezuma marshes have a total area of about 60,000 acres. The swamps in the several towns between Clyde river — in four counties — Wolcott creek and the Genesee river, cover 20,000 acres and upwards, the Tonawanda swamps in Niagara and Genesee counties cover upwards of 22,000 acres, and a continuation of those swamps and water-soaked basins in Orleans county, eastward, and Erie, westward, makes up fully 10,000 acres more. The summit swamps and wet lands, beyond all these, cover about 100,000 acres. These 259,000 acres, and more, of swamp, are generally miasmatic and the cause of unhealthfulness for considerable distances beyond their borders; and as the undrained wastes of Orange, Genesee and Niagara counties are at once the most miasmatic and — prospectively — the most productive and habitable of great swamp areas in the State, they may properly be first reported upon with reference to systematic drainage.

E. HARRIS, *Secretary.*

Public Complaint of Malaria in the Region of Eighteen-Mile Creek, Niagara County.

Upon complaint of numerous inhabitants in the town of Hartland the past two summers, the supervisor of that town was requested to secure the organization of the local Board of Health for the purpose of giving all necessary attention to the matters complained of. That Board was immediately organized on July 19, and reported the results of its investigations. As several hundred persons have petitioned that the State should interfere in this case, the following abstract of the report of the local Board of Health is here given to show in few words what its judgment is upon the subject: "We find that the Eighteen-mile creek

is mostly an artificial stream; that its original sources have disappeared with the improvement and cultivation of the country, and that if not fed by water from the Erie canal, would be a dry bed except during a short time in the spring and fall; that the stream is, and has been for years, maintained by water from the Erie canal; that the overflow into it is frequently in excess of the capacity of the creek bed, causing at points an overflow of water which sets back into low places. The water subsides, the submerged grounds dry up, and at times there are stenches emanating from these places. We are of the opinion that if the waters were kept within proper limits there would be no emanations from the creek of a hurtful character. The regulation of this water being in the hands of the canal authorities, the condition of the creek is wholly within their control and dependent upon their action."

The President of the State Board, attended by the local Board of Health and Messrs. E. Kuichling and Holmes, civil engineers, inspected the region complained of, and found that the statements made by the local Board are fairly sustained, and that most of the evils complained of by the inhabitants could and should be overcome by their own action, under the advice of the town Board of Health; that the obstructions in the sluggish water of the Eighteen-mile creek have more to do with its overflow and the unsanitary conditions of its margins, than the spillways and overflowing of the Erie canal, and that when the inhabitants are ready to do their share of the work, the State should do what is necessary to govern the course of overflow from the waste-weirs and spillways.

SENECA LAKE OUTLET, SENECA LAKE-LEVEL, GENEVA, WATKINS AND HAVANA MALARIA.

In accordance with the action taken at the meetings of the Board April 16th and May 10th, the President was directed to authorize such action by the committee on Drainage, Sewerage and Topography, as should secure the best results for repressing the causes of malaria in the region of the abandoned canals, and in regard to the Seneca lake level and its outlet.

In pursuance of this duty much information was obtained, a conference of citizens of Geneva and its Board of Health was held, and a personal inspection made through the entire district. It was ascertained that important legislation relating to Seneca lake level was pending, consequently it was inexpedient to publish the information obtained unless it should be called for by the Board or the legislature. The chief results of the investigation pursued by the President and Secretary showed that extensive sources of malaria caused by an imprudent interference with the level of Seneca lake, and with a natural degree of uniformity of outflow from it (brought about by the law of 1857 and otherwise) will need to be removed and prevented by the State. The fact appears that by greatly widening and deepening the outlet of the lake in 1857 in the expectation of improving the Seneca canal navigation, the lake level is so rapidly lowered in the early summer, that extensive shore and muddy margins in front of Geneva and Dresden and some other portions of the lake shore became miasmatic, and remain so during the entire season until the autumn high-water period. At the

same time the lake outlet, for a distance of nearly seven miles, acquires a miasmatic condition through a populous district. The excessive lowering of the lake level, seems, in the judgment of these officers of the Board, to have afforded no compensating advantage, even to the Watkins and Havana flat-lands at the head of the lake, the only region that derives any other than injurious results from the operation of the law of 1857, permitting such lowering and waste of the lake water.

The officers of the Board thus recording one of the results of their investigation are not unmindful of the fact that from 1790 to the present time the questions affecting the level of this, the most beautiful of all the lakes in the State, with its nearly ninety miles of naturally healthful border country, and seven or eight miles of outlet, have been quoted from time to time to the legislature in connection with various projects for changing the lake level.

There appears to be no doubt that the sanitary interests of Watkins, and Havana and the region of great resort at the "Glen" should be fully protected by the same authority that protects the sanitary interests at Geneva, Dresden and the Seneca outlet. The whole subject of this lake-level and the natural rights that pertain to watersides and to any hydraulic franchises in connection therewith, and in whatever way they are claimed, will have to be determined by the State. Such final settlement of the questions and rights now at issue will require that the engineering problems be clearly defined and correctly reported upon, and that this be ordered by the State, and the result be based on sanitary grounds.

Miasmatic Diseases in Eight Farmhouses From a small Swamp.

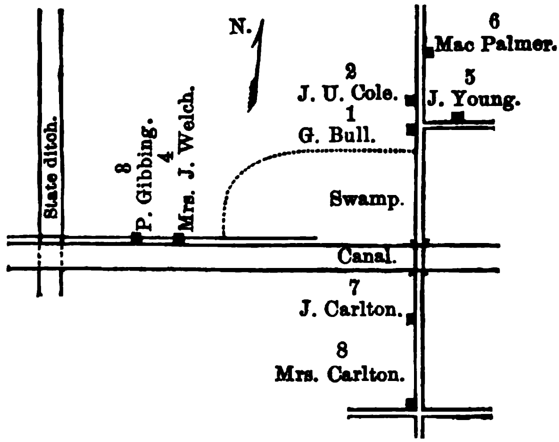
Investigation of a swamp nuisance in Murray, Orleans county.

The subject having been brought to the attention of the Board by the Hon. M. H. Phillips, the Secretary was instructed to obtain information directly from the physicians of that neighborhood. On the 12th of April the Secretary inspected the locality in company with engineer Radenhurst of the State Engineer's Department. The following memorandum from the engineer's report shows what was the nature of the evils complained of:

"This pond comprises about twenty-three acres, and consists of a basin eroded by glacial action upon the rock of Medina sandstone, and which since the canal improvement, twenty-five years ago, has been deepened and extended by the tow-path embankment. The border upon the swamp is a shallow, muddy bed, and the greatest depth does not exceed a few feet. It is in the midst of a rich farming district, and most of the homesteads near it are upon high sloping grounds."

Dr. Taylor's report to the Secretary on sickness in this region illustrates the importance of local causes of miasmatic diseases.

"I have made out this statement of different families who reside around this swamp basin who have suffered from miasmatic diseases in the year 1880:



No. 1 (six in family) four had intermittent fever; three had dysentery.

No. 2 (four in family) one had malarial fever, and all took preventives.

No. 3 (three in family) all had malarial or intermittent fever.

No. 4 (five in family) four had intermittent fever, repeated attacks.

No. 5 (five in family) two had dysentery which was malarial in its nature and causes.

No 6 (five in family) three had intermittent fever, repeated attacks.

No. 7 (four in family) three had dysentery; one intermittent fever.

No. 8 (six in family) two dysentery; three intermittent fever.

These eight families live within less than half a mile of this swamp-hole, and are distributed around it as shown in the annexed diagram. The cases of dysentery, I consider, were caused by the unhealthy pool, that produced the malarial sickness. The inmates of every household suffered more or less from malarial disease."

A Preliminary Report, by Engineer E. Kuichling, Relating to Drainage of the Tonawanda Swamps.

To the State Board of Health:

In accordance with instructions received a short time ago from your Board to prepare a statement describing the present condition and character of the Tonawanda swamps, with the view of both improving the public health in these localities and also rendering large areas available for cultivation, the undersigned would herewith respectfully submit the following report:

The presence of extensive swamp districts in a country or State is a disadvantage of no slight significance, and one that should receive the most careful consideration both from the government and society in general. Such lands not only produce no appreciable revenue, but are unprofitable, if not totally useless to their owners. They are also sources of direct loss through their miasmatic emanations, which render a large adjacent territory extremely unhealthy and sometimes absolutely uninhabitable. Even if an agricultural population can be induced to brave the dangers of malaria and settle upon the marshy soil without

possessing the means to effect its drainage, their impoverishment and demoralization is sure to follow. The history of agricultural engineering in Europe records many pitiful instances of the complete pauperization of the inhabitants of swampy districts, and hence from both social and sanitary considerations, land drainage should be classed with the most important interests of human society.

Throughout the State of New York there are distributed a great number of areas of marshy land which, from the date of the earliest settlements in the vicinity up to the present time, have been recognized as sources of malaria and disease. The most extensive and important of such tracts in the western portion of the State are the *Tonawanda swamps*, which formerly extended almost without interruption for over fifty miles along the boundaries of Genesee, Orleans, Niagara and Erie counties, from a point between the villages of Batavia and Albion to the Niagara river. These swamps originally covered a much larger area than at present, particularly in the western district, where many separate parcels of land have since been partially drained at different times and by different engineers. In consequence of such improvements having been executed without reference to a comprehensive plan for the drainage of the entire region, it now becomes difficult to discriminate sharply between the areas which are used for agricultural purposes, but are not sufficiently dry to be called salubrious, and those which still retain an unmistakable swampy character, and therefore no definite statement of the area of unhealthy land or marsh can be made without exhaustive surveys and investigations. From various sources, however, I have learned that the aggregate territory, which is either imperfectly drained or else positively swampy, and which is actually included in the tract under consideration, may fairly be estimated at from forty thousand to fifty thousand acres.

The surface of the whole low district is generally quite even, and presents the appearance of a long and comparatively narrow plane, having a nearly uniform fall or declivity of about one and one-half feet per mile towards the west. From this plane the ground rises gradually on each side until it meets the strongly defined ridges or terraces bordered by wide table-lands, which extend almost continuously in an easterly direction through the southern portions of Niagara and Orleans counties, and the northern portions of Erie and Genesee counties, and which thus mark the edges of the main hydrographical basins containing the swamps. The entire territory is divided into two principal drainage areas by the two natural outfalls afforded respectively by the Oak Orchard and Tonawanda creeks; and for the sake of convenience, each of these areas will here be distinguished by the name of its own outfall.

The eastern, or Oak Orchard creek, basin lies in the counties of Orleans and Genesee, and has a total drainage area of about eighty thousand acres, with an outlet through Oak Orchard creek northerly into Lake Ontario, while the western basin lies in Niagara and Erie counties, and has a considerably larger drainage area with an outlet through Tonawanda creek westerly into the Niagara river. The swampy district of the former basin covers parts of the towns of Alabama, Byron, Elba and Oakfield, in Genesee county, and parts of the towns of Barre, Clarendon and Shelby, in Orleans county, and extends over an area

about twenty miles long, and from one to four miles broad, containing about twenty-five thousand acres. In the western basin imperfectly drained and marshy land is still found on both sides of Tonawanda creek, in the towns of Royalton, Lockport, Pendleton and Wheatfield, in Niagara county, and in the towns of Newstead, Amherst, Clarence and Tonawanda, in Erie county, the aggregate area of these lands amounting to about twenty thousand acres.

The figures given above are based upon the statements of prominent citizens of these counties who have long been familiar with the swampy districts, and have given much time and study to the subject of improvement.

It is greatly to be regretted that accurate data giving the exact area at present covered by marsh and partially drained land in each of the above-mentioned towns are not available, in order that the sanitary and social conditions might be compared and the real effect of the swamp upon the population thoroughly studied; but, as much of the unimproved land in the several towns is known to be located either directly in the marshes, or else upon their borders where the soil is too moist for cultivation, a rough estimate of the significance of these swamps may perhaps be obtained from the statistics of the State census for the year 1875. From this source the following table, showing the relative areas of improved and unimproved farming land in the whole district, together with the population in 1865 and 1875, etc., has been carefully prepared.

Statistics from State Census of 1875.

COUNTY.	Town.	AREA OF FARMING LAND. Unimproved land, acres.	Improved land, acres.	Approximate ratio of unimproved to the improved land.	POPULATION. Number of dwellings in 1875.	Inhabitants in 1865.	Inhabitants in 1875.	Increase marked pl.; decrease marked —.	Remarks.
Genesee	Alabama	7,882	19,299	1 to 2½	399	1,839	1,809	— 30	Much swamp and no large village.
	Byron	3,027	16,022	1 to 5	362	1,645	1,696	pl. 51	Very little swamp and two villages.
	Elba	3,723	16,564	1 to 4½	388	2,044	1,937	— 107	Much swamp and one village.
	Oakfield	3,540	10,723	1 to 3	314	1,511	1,468	— 43	Much swamp and one large village.
		18,172	62,608	1 to 3½			6,910		
Orleans	Barre	7,184	24,369	1 to 3½	497	6,845	7,833	pl. 988	Much swamp, but large village of Albion and several smaller villages.
	Clarendon	5,871	14,604	1 to 2½	383	1,800	1,758	— 42	Much swamp and no large village.
	Shelby	4,509	22,230	1 to 5	796	3,203	3,868	pl. 665	Much swamp, but part of Medina and four growing villages.
		17,564	61,203	1 to 3½			13,459		
Niagara	Royalton	6,888	35,279	1 to 5	1,008	4,691	4,984	pl. 293	Little swamp and several large villa's, as Middleport, Wolcottville, etc.
	Lockport	2,907	27,119	1 to 9	3,219	13,937	15,501	pl. 1,564	Little swamp and city of Lockport, also two or three villages.
	Pendleton	2,679	14,060	1 to 5	326	1,731	1,674	— 57	Much swamp and no large village.
	Wheatfield	4,239	17,605	1 to 4	788	3,517	4,167	pl. 650	Much swamp, but part of Tonawanda and five growing villages.
		16,713	94,063	1 to 5½			26,326		
Erie	Newstead	5,953	22,550	1 to 4	727	3,206	3,467	pl. 261	Some swamp and large village of Akron, and other smaller villages.
	Amherst	4,937	25,129	1 to 5	907	4,575	4,800	pl. 225	Some swamp and large village of Williamsville, and four smaller vils.
	Clarence	7,150	24,948	1 to 3½	673	3,610	3,344	— 226	Much swamp and only one large village.
	Tonawanda	1,357	10,939	1 to 8	824	3,040	4,251	pl. 1,211	Some wet land and large town of Tonawanda, besides some small villages.
		19,397	83,566	1 to 4½			15,862		
	Total	71,846	301,440	1 to 4			62,557		

From this table it will be seen that about one-fifth of the whole area of farming land in the above-mentioned fifteen towns was, in 1875, still in an unimproved condition; but just how much of this area lies in marsh, or is only partially drained, the undersigned has had no means of ascertaining. There is, however, abundant evidence that large surfaces of such marshy land in all of the aforesaid towns have been classified by the census officials with other unimproved lands; and as the aggregate area of swampy ground in the entire district has been estimated at from 40,000 to 50,000 acres, it may be fair to assume that at least one-half of the above amount of unimproved land is in such a condition in consequence of the existence of the said swamps. The table also shows that in 1875 the territory specified was inhabited by 62,557 people, most of whom were exposed to the malaria arising from the undrained and wet localities. Of this population, about 26,500 dwell in the city of Lockport and the larger villages of Albion, Tonawanda, Medina, Williamsville, Middleport, Wolcottsville, Akron and Caryville, and about 4,300 in the smaller villages and settlements of Clarence Hollow, Pine Hill, Bergholtz, Gasport, Martinsville, Johnsburg, Pendleton, Millville, South Byron, Orangeport, Shelby, Barre Center, Clarendon, Alabama Center, Royalton and Byron, thus leaving about 31,750 inhabitants in the strictly rural areas of the district. Although a number of these places are situated upon the high table-lands surrounding the hydrographical basins, yet the majority are located in the lower areas, and some, indeed, directly in the midst of tracts which are only partially drained. Under these circumstances, there can be no doubt that thorough and systematic drainage should be considered necessary, and that a great sanitary improvement would result throughout the whole region.

The evil effect of the swamp upon the population is also very strikingly exhibited by the foregoing table, since in every one of the several towns which contains no flourishing city or village, a large diminution in the number of inhabitants during the specified period of ten years will be observed. This circumstance can doubtless be ascribed to the prevalence of malaria and the unproductiveness of the saturated soil on the margins of the swamp. A comparison of the conditions existing in the several towns of Genesee county is especially favorable for proving the correctness of this view. All of these four towns are essentially rural in character, as they have no large and growing villages which tend to concentrate the population. In Byron, which has only a few hundred acres of marshy land, we find an increase of 51 inhabitants, while in the adjacent towns of Elba and Alabama, in which the swamp covers an area of about 9,000 acres, a decrease of respectively 107 and 30 in the population is observed.

From the reports of local physicians and health authorities, it appears that malarial diseases are becoming more prevalent and more malignant throughout the whole of the swampy territory, and frequently, also, extend themselves to the higher lands on each side, so that the importance and necessity of a systematic drainage of this extensive district is becoming apparent to many of the inhabitants. Without entering upon a discussion of the precise character of malaria, it may safely be asserted, in view of recent careful investigations, that:

1. Any organic matter undergoing decomposition in or upon the

ground in consequence of being alternately wet and dry, will generate gases and various chemical and organic products which are either directly injurious to human health, or else will bring about conditions particularly favorable for the development of the subtle poison which is termed malaria or miasma.

2. That this poison is found in large quantities and is widely disseminated through the soil of malarial districts at a season when people are not yet attacked by disease.

3. That at these times the poison may also be found in especially favorable places in the strata of air nearest to the surface of the infected ground.

4. That under certain conditions of the atmosphere, the poison is liberated in large quantities, whereupon it is taken up by the air and distributed over a large extent of adjacent territory, thereby generating peculiar diseases among human beings and domestic animals.

5. That these particular diseases are most prevalent in swampy and undrained districts, and very often become epidemic.

But in addition to its pernicious influence upon human health, the presence of stagnant water is also highly injurious to the quality of land for agricultural purposes, as it prevents the entrance or penetration of the rain, and consequently also the necessary circulation of air beneath the surface. It is a well-known fact that the mechanical action of the rainfall is an important factor in agriculture, as through it the atmosphere gains an entrance into the soil and supplies the oxygen required by all plants. In wet ground, therefore, the oxidation of organic matter can progress very slowly; and instead of the soluble salts and harmless compounds which are the ultimate products of rapid decomposition, a series of unstable chemical combinations will be generated by the slow decay of such matter which are detrimental to the growth of marketable vegetables. When a plant dies upon a dry surface, only a comparatively short period of time will elapse before all traces of its original structure become obliterated, and its organic matter appears to have vanished into air; but if such a plant be immersed in stagnant water, and thus excluded from the action of the atmosphere, it will blacken and perhaps gradually crumble, yet in bulk it will long remain where it was originally deposited. Should other plants grow up, die, and fall upon the same spot, the process will be repeated, and the black muck or vegetable mould thus produced will accumulate from year to year, until it attains, often, a formidable depth.

The excessive moisture, furthermore, prevents the warming of the soil by the sun's rays and the heated atmosphere which is essential to the success of almost every profitable crop; and by evaporation, on the other hand, it abstracts warmth from both the soil and the air. Wet ground is therefore always cold, and the produce raised upon it is consequently late in ripening. Many varieties of weeds also flourish in such soil, so that reeds, rushes and mosses are frequently observed to crowd out completely the valuable grasses and garden plants which are objects of cultivation. As all of these unfavorable conditions prevail upon the Tonawanda swamps, it is obvious that systematic drainage alone will give to the land a commercial value and render it fit for useful production.

The physical characteristics of the two great drainage areas are substantially identical, and hence any particular descriptions will apply to

both. In the depressions, limestone rock of the Niagara group is generally found at a shallow depth, overlaid by a deposit of clay, while the surface soil is muck and marl. In Genesee and Orleans counties, this muck is black and very rich, and attains a depth of several feet; while in Niagara and Erie counties much clay and loam are mingled with the vegetable mould, thus making the surface ground more compact and impervious.

The rocky strata are nearly horizontal, having only a slight dip to the west and somewhat more to the south. Towards the west the strata also break off in a series of small steps or worn terraces, thereby giving the surface a general and gradual descent in that direction. In view of these peculiarities, the principal causes which induced the formation of these swamps are obviously, — first, the large extent of the drainage areas and the nearly level surface of the bottom of the basins; second, the impervious character of the substrata, by which the ready absorption of the rainfall is prevented; third, the appreciable dip of the rocky layers to the south, whereby the efficiency of any natural outfall in a northerly direction is greatly diminished; fourth, the lack of natural outfalls of suitable dimensions and declivity to both the west and the north, through which the surface drainage, as well as the water from the numerous permanent springs and brooks abounding in the locality, could promptly be removed; fifth, the existence of a series of natural and artificial obstructions in the original water courses, which both retard the discharge and occasion a rise in the level of the subsoil water; and sixth, the gradual elevation of the beds of the natural streams flowing into and through the swamps by accumulations of silt which cannot be scoured away in consequence of defective or obstructed outfalls. Through the action of these causes, accordingly, the drainage waters have been compelled to spread out over extensive low areas and become stagnant upon or near the surface of the soil, thus rendering it marshy and preventing its agricultural utilization.

The black muck, which is distributed over the whole of the Oak Orchard creek swamp, and also over many parts of the Tonawanda creek swamp, is evidently very fertile. In the former area it sustains, even in its present wet condition, a dense vegetation, consisting principally of large and flourishing elm, ash, oak, soft maple and cedar trees, together with a thick undergrowth of alder and other bushes, as well as an enormous quantity of aquatic plants; while in the western area, those portions of the land which have already been drained are famous for their large crops of grain and other farm produce. It must be remembered that muck of this character is usually rich in nitrogenized constituents as much as two per cent of nitrogen being frequently found by chemical analysis. This element is a principal constituent of manures and other fertilizing agents; and in such, its value can be rated at twenty-five cents per pound. A ton of muck, therefore, containing two per cent or forty pounds of nitrogen, would be worth ten dollars; and hence the prospective value of these lands can readily be estimated. The muck, however, requires thorough drainage and manipulation before its fertilizing properties can be made fully available; but notwithstanding the labor and expense thereby involved, it is sufficiently evident from the foregoing that a vast amount of wealth at present lies idle and neglected in the great bogs under consideration.

Previous to 1820, the swamps of the two great drainage basins were

practically continuous; but in that year the canal authorities of the State cut an artificial channel about four and three-fourths miles long in a northerly direction through the marsh from Tonawanda creek, in the town of Alabama, to a point where Oak Orchard creek issues from its swamp sources and flows thence with considerable declivity towards Medina. The purpose of this channel was to supply the Erie canal with water on the long level from Lockport to Rochester, and the creek was accordingly converted into a part of this feeder. But in constructing the artificial channel, a low embankment was formed along its course over the originally continuous marsh, and thus the latter was actually divided into the two areas defined above by preventing the flood waters of the eastern section from flowing westerly into the outfall afforded by Tonawanda creek. It is therefore evident that when the feeder was in full operation, a large volume of water was diverted from Tonawanda creek, conveyed across the swamp, and discharged into Oak Orchard creek, in consequence of which its defective character as an outfall for the eastern swamp was rendered worse by being charged with the delivery of a great additional quantity of water, so that the flood waters from its own proper drainage area were set back and their discharge considerably retarded. Extensive tracts which were formerly cultivated without particular annoyance from floods thus became overflowed in rainy seasons, and remained so for such length of time as to cause much loss and suffering. Relief at last became necessary, and the outfall was improved by a partial removal of the rocky bed of the creek at the northern margin of the swamp; but the benefit thus derived was rather limited in extent and the large Oak Orchard creek swamp still remains practically undrained. In this connection, however, it is proper to state that the canal authorities assert that the feeder and creek have been greatly improved, and that such improvement has more than compensated for the additional height produced in the water surface of the creek at the times when the head-gates of the feeder are opened at Tonawanda creek. To determine clearly whether the State has any further duty in the matter is not now the writer's province, as this would require the expenditure of much more time than has at present been granted.

The construction of the artificial channel across the marsh, however, was of service to the western section, as much flood-drainage was intercepted by it and carried into the northern outfall. Drainage in this portion was thus rendered easier, and the area in the course of time lost much of its swampy character. Great improvement in the district as a whole is nevertheless desirable, as the soil is still too moist to be regarded as guaranteeing immunity from malaria. In many places, also, large patches of marsh occur, which can not be drained by the existing ditches, and which consequently remain to breed the fevers affecting these localities. This difficulty is doubtless due to the fact that the plans for drainage were limited only to comparatively small areas, and were executed at various intervals by different parties, so that the want of a comprehensive system for the improvement of the entire territory included in this western section now becomes plainly apparent.

As for the Oak Orchard creek swamp, its course and position in the landscape can readily be traced by the gloomy forest which extends almost unbroken and impenetrable for miles in the directions already

indicated, and which serves at present only as an abiding place for loathsome reptiles and the far more dangerous germs of malarial disease. The removal of these poisonous emanations by well-considered and systematic drainage may therefore properly be presented as an urgent public necessity, particularly since no serious topographical difficulties prevent this area from soon being converted into one of the richest and most salubrious agricultural sections of the whole State.

Much attention has of late been directed to the sanitary improvement of large cities and towns, as the subject has become one of national importance. The best scientific and practical talent in the world has been induced to enter this service, and in all of the numerous published reports and descriptions of such work in cities, the greatest stress is laid upon the element of thorough drainage, in order to preserve the public health and thereby protect the great interests of commerce and manufacture, which constitute a nation's wealth.

Illustrations of the benefits to be derived from lowering the level of the sub-soil water are, however, not confined to cities alone. The reclamation of vast marshes and the drainage of extensive bogs and wide agricultural districts have uniformly been followed by such increase in value of land, and by such immediate disappearance of the malarial diseases which prevailed in former times, that the highest expectations of the promoters of these schemes have been fully realized. Numerous instances of this kind might easily be adduced from all parts of the world, but for the sake of brevity we will cite only a few of the more important cases which have been executed in England, Holland, France, Germany, Italy, and the United States.

The Fen districts of England, sometimes also called the Bedford level, were once a series of extensive marshes, stretching along the eastern coast for a distance of about 130 miles, and from five to thirty miles in width. Previous to the execution of the drainage, these lands had little or no value, and in the spring-time the occurrence of ague in every family of the population used to be the rule, so that the presence of these causes of poverty and disease became a grievous burden to the entire state. During the reign of Charles I. measures were taken to ameliorate the condition of these localities, and the work has steadily progressed until now almost the whole of the districts have been brought under successful and highly profitable cultivation, and have become rich in corn and cattle. Marked improvement in the sanitary condition also invariably followed the drainage of district after district, and very soon the ague had practically disappeared. It recurred, however, at intervals in the autumn instead of the spring, as formerly, but it was soon discovered that the drainage had been carried beyond the limits of prudence by permitting the ditches to become nearly, or quite dry throughout the hot summer months, whereby large exhaling surfaces were exposed to the air and heat, and a noxious effluvium was generated from the decaying organic matter. The recognition of this fact immediately suggested a simple and efficient remedy, which consisted merely of the introduction of water from convenient higher sources into the drainage ditches during the dry season, and by which the malady was again permanently banished.

In Holland and the Netherlands drainage is vitally necessary, as a large area of the richest agricultural territory of these countries lies

several feet below the level of the sea, from which it was reclaimed by the exertions of the Dutch engineers. The drainage of the Haarlem Meer, yet in progress, will eventually bring under cultivation about 45,230 acres of the most fertile soil, and thus add enormously to the general wealth of the state.

France has recently executed a highly important work in the drainage of the "Dombes," a large district north-easterly of Lyons, and which was formerly notorious for the unhealthiness of its climate. The surface formation consists principally of a mixture of flints, sand and gravel, cemented together with alumina, peroxide of iron and silex, into an impervious material, beneath which are found deposits of permeable gravel and loose rocks. Lying at a low level, a great part of this district was covered with marshes and small lakes or ponds, which prevented the agricultural utilization of the area and became vexatious sources of malaria. The improvement of this land was at length undertaken by the government, and since 1853 about 25,000 acres have been reclaimed and put under cultivation, railways and a system of roads have been constructed, and numerous wells have been sunk in order to obtain a sufficient supply of water suitable for drinking purposes. The cost of these works during the past twenty-five years has been about $1,400,000 ; but the outlay has proved wise and profitable, since the increase of the direct and indirect taxes are more than sufficient to pay the annual interest. During this period, also, the population has increased thirty-three per cent, the average duration of human life has been raised from twenty-two and five-sixths years to thirty-eight years and the general character of the climate altered in a marked manner.

The results of the important drainage works which have been executed during the past twenty-five years, in various parts of Germany and Switzerland, also serve to prove that drainage for health is drainage for wealth. In the valley of the Unstrut, a small stream in Saxony, large swamps occurred, which generated fevers in the locality to an alarming extent. Upon a single large estate in this valley, one-third of all the people were continually afflicted with fevers, and in the neighboring village of Gehofen, which had about thirteen hundred inhabitants, the sanitary records show that from fifty to sixty cases at a time of malarial disease were frequently registered. Throughout the year following the completion of the drainage works not a single case of fever was reported, and the benefits of the improvement were also noticeably felt by domestic animals. At one place in this valley, the mortality among sheep was reduced from twenty-six and six-tenths per cent, to twelve and three-tenths per cent, and among cattle, from ten and five-tenths per cent, to eight per cent; and at Gehofen the statistics show a reduction in the death rate among sheep from fifteen and twenty-five one-hundredths per cent, to eleven and seventy-five one-hundredths per cent. and among cattle from five per cent to two and five-tenths per cent. Similar advantages resulted from the improvement of a portion of the valley of the Oder, north-east of Berlin. This district, which embraces many thousand acres, was likewise afflicted with extensive marshes, and was considered so unhealthy that only about one hundred and seventy families were dwelling upon it previous to the drainage. The reclamation of the land here again wrought a wonderful change in the climate and value of the soil, as within only a few years after its completion, the population of the district increased to twenty-four thousand.

In Italy, the subjects of land reclamation and the abatement of the pestilential vapors generated by a number of extensive swamps have attracted much attention. The Pontine marshes in the vicinity of Rome, the swamps in the Chiana valley near Florence, and the Maremma, a vast marshy region, embracing an area of nearly one thousand square miles, on the coast of Tuscany, were formerly fruitful and populous plains; but by long neglect of the natural water-courses of the districts, these rich low-lands gradually became converted into marshes aud prolific sources of miasmata, prejudicial alike to man and beast, until at length the few surviving inhabitants were compelled to remove and leave the land to utter desolation. Various projects for the amelioration of these districts were undertaken with excellent results, notably in the Chiana valley, which has since become exuberantly fertile, forming a perfect garden, supporting at the present time a population of more than one hundred thousand.

The recently completed drainage of Lake Fucino, which a few years ago covered the greater part of certain high table lands about fifty-three miles east of Rome, affords another striking illustration of the significance and national importance of such works. This great improvement appears to have been conceived by Julius Cæsar, and was afterward partly effected by Claudius and Hadrian; but the ancient works were subsequently allowed to fall into decay, whereby the lake soon resumed its former extent and malignant character. The new project was completed by private enterprise in June, 1875, and the lake is now entirely drained, thus reclaiming thirty-five thousand acres of the finest arable land, and changing the face of a whole province by bringing health, industry and prosperity into a region where fever and pauperism had previously held undisputed sway.

In our own country the subject of systematic drainage has not as yet received the general and energetic attention which has been devoted to it elsewhere, on account of the abundance and cheapness of salubrious fertile lands, and the relatively small population per acre in agricultural districts. Extensive drainage works have therefore usually been executed only in the vicinity of large cities, and other populous localities, where the imperative necessity of preserving the health of a dense population,and of obtaining valuable land for the growth and sustenance of the community has been recognized.

Vast areas of unreclaimed swamp-land, however, exist along our coasts, and also upon the elevated plateaus and broad valleys of the interior. From their particularly advantageous location, and the inherent richness of their soil, many of these marshes are steadily increasing in prospective value for agricultural purposes, and have already attracted the notice of capitalists, as well as of sanitarians. The swamps in Westchester and Orange counties, in this State, afford excellent illustrations of this statement, and the successful drainage of a tract containing about five hundred acres of pestilential marsh near Goshen, in Orange county, will serve to demonstrate the benefits of systematic drainage from a sanitary as well as a financial standpoint. Twenty years ago the district in question was pronounced dangerously unhealthy in consequence of the malaria generated in the extensive swamps, and the value of the undrained land was then only about one dollar per acre. The artificial lowering of the subsoil water level, however, quickly dispelled the miasmata, and laid dry a soil composed of the finest black

muck, which subsequent cultivation proved to be of fabulous richness. As soon as this fact became apparent, the price of this reclaimed land speedily advanced, until now its average value is estimated at five hundred dollars per acre. This high price resulted from the extraordinary adaptability of the soil to the culture of onions, crops of eight hundred bushels per acre not being uncommon, and their quality becoming celebrated throughout the country. The success of these onion-meadows quickly led to the reclamation of similar lands in other parts of the neighborhood, so that in 1879 the onion crop of Orange county, was reckoned at five hundred thousand bushels. The soil is tilled with very little labor, and the average yield is estimated at three hundred bushels of onions per acre.

From the few examples of well designed drainage work just cited, a comprehensive view is afforded of some of the more important advantages and benefits which are derived both by individuals and society from the reclamation of marshes and wet lands. In every instance it will be found that such improvements are quickly followed by increased health and duration of life in the district, as well as by large pecuniary profits, which will amply repay the labor and capital expended in draining the soil. To illustrate how speedily the beneficial effects of removing stagnant water are felt, we may further adduce the case of the recent drainage of the bed of the lately abandoned Chemung canal, between the towns of Horseheads and Havana, in this State. Upon the removal of the water from the canal, the latter became the receptacle of a large amount of intercepted surface-drainage, which had no opportunity to escape from the artificial channel, and accordingly became stagnant therein. The result was that malarial diseases soon became very prevalent along the route of the canal, and the subject was finally brought to the notice of the State Board of Health, who thereupon instituted proceedings to insure the discharge of any drainage which might find its way into the abandoned channel. The work thus rendered necessary was performed last July, under the supervision of your Board, and already in September the sickness had almost entirely ceased along a course of nine miles, where nearly all had been suffering from miasmatic fevers.

In regard to the practicability of draining effectually the two basins of the Tonawanda swamp territory, and of rendering them more healthy, it will be sufficient merely to refer to the topography of this entire district, and to give a few data of relative elevations in order to dispel any doubt of its successful and economical accomplishment. As has already been stated, the general surface of the flat lands, in both basins, slopes towards the west at a nearly uniform rate of one and one-half feet per mile. In a stream of moderate size, a descent of this magnitude would create a strong current, and it is also amply sufficient for the prompt removal of water in all properly designed main-drainage ditches. The western basin, therefore, if permanently relieved from the floods of the eastern district, can easily be improved, and the marshes therein converted in fertile gardens. Systematic and general action throughout the whole area, however, is imperatively necessary in order to secure beneficial and lasting results. The work already performed can be utilized and enlarged wherever required; and thus the value of the land and the health of the inhabitants might be greatly increased at comparatively small expense.

The eastern basin, on the other hand, is susceptible of being thoroughly drained into the outfall presented by Oak Orchard creek, as will be seen from the following data. From the head of the swamp to the feeder the general surface of the ground falls at the rate of one and one-half feet per mile; and the junction of the artificial channel with said creek at the northern margin of the marsh is about one hundred and one feet above the water surface of the Erie canal at Medina, the distance between these points being nearly seven miles. Although this rapid descent is not uniform, on account of numerous small cascades, yet by deepening the bed of Oak Orchard creek for two or three miles northerly from the swamp, a fall of ten feet can be obtained, which would afford an excellent outfall for the drainage of the twenty-five thousand acres of marsh in the counties of Orleans and Genesee, and perhaps also for the waters from a considerable area on the western side of the feeder. It is therefore evident that with such topographical opportunities, no serious difficulty can be said to stand in the way of the reclamation of the entire eastern district; and it seems almost incomprehensible that in the heart of a region, so famous for its beauty, fertility and high agricultural improvement, this large tract of waste land, which is so easy of access and cultivation, has not long since been changed from a colossal nuisance into a source of enduring wealth.

The problem of the sanitary drainage of these two large basins in all its details is, however, by no means simple, and will require a vast amount of careful study and elaboration before a solution can be submitted which will meet all the conditions that circumstances now impose. The State has important interests in the conservancy of the waters of both districts for the supply of the Erie canal; and individuals have privileges which must be respected, since these waters are sources of power for various industrial pursuits; but each must take cognizance of the great sanitary and economic interests which are essential to the prosperity of the great commonwealth.

A proper plan for the improvement of these two vast swamp areas must accordingly take all of these varied interests into account, and must also furnish devices for preventing the destruction of the reclaimed peaty soil by fire, as well as provisions for maintaining in it the degree of moisture required for profitable cultivation. New roads, moreover, are needed to develop the reclaimed territory by affording ready means of access and communication; and care should be taken in their construction to prevent them from becoming serious obstacles to the natural flow of the surface and subsoil waters.

As time rolls on, new interests are liable to arise from the exigencies of communities, corporations and individuals, which will only complicate the problem and tend to a postponement of the work of drainage. It has already been stated that numerous detached areas in the swampy districts have been rendered fit for cultivation, perhaps, but have not been improved sufficiently to warrant their being pronounced healthy. Experience in other localities also demonstrates that the principal aim of such works, which have been executed by private enterprise, is to adapt the marshy land for agriculture with the least possible expense and to leave the more important sanitary considerations wholly out of sight. In all such cases of unsystematic or disconnected drainage, the results have proved unsatisfactory, and great difficulty is generally en-

countered in persuading the owners to incur further outlay by improving the means for lowering the level of the subsoil water. It is therefore apparent that the drainage of large swampy areas should in the very outset be treated upon comprehensive plans in order to secure and maintain outfalls capable of removing the surplus water in proper time; and that a strict adherence to the system of ditches and drains co-ordinated with the outfalls is absolutely necessary to insure general welfare and to give health and wealth to the entire district.

Sanitary considerations, furthermore, demand that the drainage of the marshy territory under discussion should be effected before the forests, which still cover the greater portion of the Oak Orchard creek swamp, and many smaller areas in the western basin, are hewn down and supplanted by a rank growth of essentially aquatic vegetation. The demand for timber is constantly increasing, and a time will soon arrive when it will become profitable to remove the trees in this locality, despite the attendant difficulties. A large amount of decaying organic matter will then be exposed directly to the burning rays of a summer sun, and the evolution of malaria or poisonous gases will be correspondingly augmented. In the shade and quiet of the forests, on the other hand, decomposition takes place more slowly, and the wind, not having opportunity to sweep unrestricted through the marshy region, will therefore not spread the noxious exhalations so readily over a wide extent of country. Large trees, moreover, will absorb any surplus moisture that may be left in the ground after the completion of the primary drainage works much more rapidly than the mosses, rushes and swamp grasses which quickly spring up after the denudation of the surface.

The undrained lands have now little or no value, but when they have once been improved by systematic drainage and intelligent cultivation, there can be no doubt that their value will become as great, and perhaps even greater, than that of the adjacent dry lands, which at present ranges from $50 to $100 per acre. The wealth thus accruing to both individuals and the State from the reclamation of these waste lands can therefore readily be computed. An increase in the population of the districts would also follow the drainage of the soil; and if the low rate of one person to every ten acres of land be assumed for the calculation, it will be safe to conclude that at least 5,000 industrious inhabitants can gain a livelihood from agriculture upon the 50,000 acres which are now covered by swamp and imperfectly drained land. The general health of the whole locality would likewise be greatly improved; and, as in other countries, broad fields and rich meadows would soon be found in the present fever infested areas.

In the foregoing, it has been the writer's aim to give a fair description of the large tracts of marshy land in western New York which have long been known as the Tonawanda swamps, and to point out the principal physical characteristics in consequence of which the eastern area of low land has remained a desolate marsh, while the western basin has been considerably improved. Brief reference has also been made to the evil effect of swamps upon the prosperity and health of the inhabitants, and this has been illustrated more definitely by the citation of a number of instances of successful drainage, wherein the varied benefits resulting from such works have been made manifest. The practicability of reclaiming the swamps in question has likewise received some attention, and the principal elements which would have to be taken into account

in any scheme for the systematic improvement of the territory have been indicated. Many more details could easily have been added, but only at the cost of conciseness and the broader view of the subject which is required in the preliminary work. Prominence has been given to the motto that "drainage for health is drainage for wealth," and to the assertion that by a well-devised and carefully executed system of outlets, extensive districts like the Tonawanda swamps can be reclaimed and made highly profitable to both the land owners and the State.

In the creation of wealth, however, man and nature must operate together, for it is only when made available by the agency of human intellect and power that the contributions of nature can attain a value. But sound physical health is the real basis of such human power, and hence the protection and enlargement of this power by zealous watchfulness over human health should be the chief responsibility of every government.

In conclusion, permit me to acknowledge the receipt of much and invaluable assistance in the preparation of this report, from Dr. Elisha Harris, Secretary of your Board, and also from Hon. J. W. Holmes, of Genesee county, both of whom have for many years devoted much time and study to the great problem of converting these malarial districts into magnificent and salubrious gardens. It was also my desire to accompany this paper with a reduced copy of an excellent map of the Oak Orchard creek swamps, which was carefully prepared by Hon. Mr. Holmes, and kindly loaned to me for the purpose, but lack of time has prevented me from carrying out that design.

Respectfully submitted,

EMIL KUICHLING, *Civil Engineer.*

REPORT.

To the State Board of Health, on the Methods of Sewerage for Cities and large Villages, in the State of New York.

By JAMES T. GARDINER,
Director of the New York State Survey, Chairman of Committee on Drainage, Sewerage and Topography.

The advice of this Board has been so often asked by cities and villages of the State in reference to the proper disposal of their sewage; and the complaints are so numerous of disease and death attendant upon the present ways of treating this matter in most towns; that it has become necessary to determine whether among the many means in use there is any plan of taking away the sewage of towns healthfully, efficiently and cheaply. I say *of taking away*, because the custom of storing up the filth of towns in privy-vaults and cess-pools, to poison the earth and contaminate the water and air, is one against which all the influence of this Board should be exerted.

The awful lessons taught by epidemic disease are awakening the towns of the State to the need of relief from the prevailing privy-vault and cess-pool nuisances.

What shall be done with the sewage of these many populous towns of New York; how can it be best removed from the dwellings, is the question I have endeavored to answer since the resolution of the Board instructing me to examine, during my recent journey, the results of European experience in sewerage.

I find in general that wherever intelligent efforts have been made to produce proper sanitary conditions for towns, cess-pools and vaults are abolished; and the sewage is *removed* from the neighborhood of the dwellings by "dry removal," or by "water carriage," which is sewerage.

Dry Removal.

The two common methods of "dry removal" are by the use of the dry earth closet, and the cask, or "pail" system.

In the former the urine and fæces fall into a receptacle, and dry powdered earth is added after every evacuation. This dry earth,

when of the proper kind, both deodorizes and decomposes the fæces so that they disappear. The compost is removed at *infrequent* intervals and used as manure. The success of this method depends on a proper supply of loam, or clay, dried and powdered, the prompt covering of the fæces after every evacuation, on the removal of the compost and thorough cleansing of the receptacle, and in ventilation of the closet. Without the fulfillment of all these conditions the earth closet soon becomes a nuisance.

In practice it is found that the provision of proper earth, and the constant intelligent surveillance necessary cannot be secured from any but exceptional families. The system of dry earth removal cannot therefore be safely recommended for towns in which so large a proportion of the people are always ignorant and careless.

The Tub or Pail System.

The tub, cask or "pail system," used even on a large scale in England, France and Germany, is undoubtedly the best method of removal where towns have neither water supply nor sewerage.

In this system the excreta are allowed to fall into a tub or cask, in England called a "pail," which is removed, emptied, and thoroughly cleaned by the town authorities at least once a week, some disinfectant being placed in the tub after cleaning. In Manchester, England, sifted ashes are added during use to the contents of the tub as a deodorizer.

The simplest form of this method of removal, and the one most applicable to the villages in the State of New York, is that employed in Rochdale, and in Manchester, England.

Rochdale is a city of some 70,000, and Manchester of between 400,000 and 500,000 inhabitants. The higher class of houses are allowed to have water-closets, but four-fifths of the people are obliged to have "pail closets" in their yards built according to plans of the Health Department. Their essential features are: A flag-stone floor raised a few inches above the level of the yard; a hinged seat with a metal rim underneath for directing urine into the pail, which stands on the flag directly beneath the seat; a hinged front and back to the seat so that the pail or tub may be easily taken out and the place cleaned; and a six-inch ventilating pipe from under the seat to above the roof. In Rochdale they use a wooden pail or tub made of half of a disused paraffine cask holding about 100 pounds; in Manchester the "pail" is of galvanized iron and holds ten gallons. Under the direction of the authorities they are removed once a week in covered vans, which bring clean tubs to be put in the place of the full ones taken away. Each tub is covered with a close fitting double lid before removal. The tubs are taken to a depot, where their contents

are deodorized and prepared as manure by mixing with ashes and a small proportion of gypsum to fix the ammonia. Subsequently street sweepings and the refuse of slaughter-houses are added. At Manchester there is by the side of each closet a very simple ash sifter, from which the ashes fall into the tub and help to deodorize its contents.

The manure at Rochdale sells for about four-fifths of the cost of its collection and preparation.

In 1873 the net cost to the town of removing and disposing of the house dry refuse and excrement was only about $95 per annum per 1,000 of population; less than ten cents a person per annum.

The system has been in operation more than twelve years.

The tubs are removed in the day time without offensive odor.

Where ashes are frequently thrown into the tubs at Manchester very little odor is to be perceived in the closets.

For the villages of the State which can have no general water supply, I would unhesitatingly advise the use of the "pail" or tub system as practiced in Manchester, England, as being, from a sanitary point of view, an immense improvement over the death-breeding *privy-vaults* in common use. The cheapness of the plan and the smallness of the original outlay of brains and money, in comparison with that needed to build a good sewer system, will make it possible to introduce a tub-privy system into most villages half a century before sewers would meet with any consideration.

At a small cost the existing privy-vaults can be cleaned and filled, and the privies altered into healthful tub-closets. The town authorities must then arrange for the removal of the tubs once a week, and for their thorough cleansing and disinfecting. Any isolated house or group of houses can use the tub system, taking care of it themselves. If the plan is adopted in villages, it will doubtless spread into the country, and become the most powerful means of abolishing the fatal privy-vaults which are poisoning the farm wells.

Believing as I do that privy-vaults are such an active and wide-spread means for breeding disease and bringing needless sorrow and death into hundreds of houses; and being convinced that in this country, as in Europe, the tub system will be found the most immediately practicable, efficient remedy, I recommend to this Board to take measures to secure its adoption in villages and towns where sewers are not likely to be built.

The weakness of the "tub system," as it should be called in this country, is, that the removal, cleansing and disinfecting of the tubs requires constant care and is a standing expense. Careless, ignorant, or parsimonious village authorities may, by neglect or from false economy, fail to provide for the removal and proper cleaning of the tubs

at sufficiently frequent intervals; but under no circumstances would the evils of this neglect be comparable with those of privy-vaults. The small size of the tubs puts a narrow limit to the interval between removals, and compels attention.

While this system is immeasurably more healthful than privy-vaults, it is unavoidably inferior to that of sewerage, in that it does not provide for the removal of waste-water and slops. In Rochdale and Manchester they have been obliged to build sewers and drains for slops, waste-water and storm-water.

"Water-Carriage" or Sewerage.

Large villages and towns, where population is so dense as to render the use of wells dangerous, require an abundant supply of pure water distributed through the town in pipes. Means must be provided for the removal of this water after it has been used. Towns with water supply, therefore, find themselves called upon to provide for the removal of excreta, waste-water slops, and storm-water. In Manchester, Rochdale, and other English cities and towns, in Paris and other continental cities, the experiment has been tried of carrying off the human excreta in tubs, while waste-water slops and storm-water are led away in sewers. But the inconvenience, expense, and rigid supervision necessary in the tub system, as applied to large towns, has induced most of the larger cities both in Europe and America to provide for carrying away human excreta with waste-water from the dwellings by drains into the sewers, which already existed for the purposes of draining off more or less of the storm-waters falling on streets and yards. Sewers for disposing of surplus storm-water being necessary in many places, and being already in existence when general water supplies were introduced, it seemed most economical to extend them, and to drain into them both waste-water and human excreta in addition to the storm-water, for which alone they were originally intended. This was the origin of the "combined system" of sewerage, in which the sewers are arranged to carry off excreta, waste-water slops, and storm-water. The large size of these sewers is made necessary by the admission of storm-water.

The great expense of the "combined system" of sewerage, the difficulty of keeping the large sewers clean, and the increasing difficulty of disposing of quantities of diluted sewage have led to the further experiment of building a system of small sewers to carry away only waste-water and human excreta, which are properly sewage; and disposing of storm-water by surface gutters and short sewers leading to the nearest natural water-courses. This is known as the "separate system" of sewerage.

The combined system of sewerage.—This system of sewerage can only be economically used where it is necessary to provide, even at large expense, for carrying off the storm-water underground. The storm-water falling per hour in violent rains over an acre of closely built up city land is nearly fifty times the amount of the waste-water and sewage produced per hour on the same area. The sewage is, therefore, ordinarily a mere trickling thread in the bottom of a sewer large enough to carry off great bodies of storm-water. In time of rain the sewer will be nearly or quite full of dilute sewage, which is absorbed by the bricks, and leaves a coating on them as the water falls. The powerfully flowing stream of storm-water on subsiding deposits silt in the bottom of the sewer which obstructs the flow of sewage, giving it time to decompose. Foul gases are then emitted, and it has been popularly assumed that these gases, called "sewer gas," are the cause of disease.

Physicians are agreed upon the fact that air from sewers passing into a dwelling is very likely to produce serious disease. That this illness is due to a *gas* from decomposing sewage is a mere assumption unsupported by proof. But the hypothesis was hastily adopted by engineers, who naturally inferred that the healthfulness of large sewers would be secured if they could only drive out or sufficiently dilute this gas by ventilating the sewer, or prevent its formation by keeping the stream of sewage flowing uninterruptedly. The discussion of the subject by Mr. Elliot Clarke, in the Massachusetts Board of Health report,* and the opinion of other engineers who favor large sewers, seem to be based on this idea.

It is time, therefore, to call attention to the fact that *no such gas as "sewer-gas"* exists, and that *there is absolutely no proof that the diseases which attend the admission of sewer-air into a dwelling are produced by gases.* On the contrary the whole tendency of modern investigation is to show that the zymotic diseases are produced by *bacteria*,† whose germs are developed under favorable conditions. It is well known that the most favorable conditions for the growth of these low organisms are heat, moisture, darkness and the *presence of ammonia.* The damp walls of sewers present, therefore, all the requirements for a most flourishing growth of bacteria, whose germs may float off on the sewer-air and be carried into dwellings by mechanical action, as dust is borne on any air current.

It is, therefore, most probable that sewer-air brings the germs of disease into dwellings as dust is blown into the window. The foul gases of decomposition may or may not be present. The fatal power over

*Second Report Mass. State Board, New Series, 1880.

†The Medical Members of the State Board do not admit or deny that there is such a tendency. It is the author's privilege thus to express his belief. E. H., *Secretary.*

life lies, probably, in the little plant-seed, odorless and invisible, floating upon the sewer-air.

Large sewers are, then, plantations for the propagation of deadly organisms, the moist, porous walls forming most favorable soil, the ammonia of sewage supplying the manure essential to full development, and the warm, damp air stimulating to the utmost all processes of growth.

The occasional flushing of sewers, while it may clear out silt and accumulated filth, and thus decrease the amount of heat and ammonia from decomposition, can never prevent the growth of bacteria on the sewer walls, nor will ventilation prove efficient. Every device of engineering has been exhausted to keep large sewers clean and well ventilated, but the air from them is still deadly. Experience, therefore, teaches that there is some radical defect in the system of large or combined sewers, while modern investigations of the origin of zymotic diseases and the mode of growth of bacteria seem to show that sewer walls are almost ideal hot-beds for the production of fatal organic germs. Perfect plumbing may prevent sewer-air from entering dwellings, but perfect plumbing will always be the rare exception.

In view of these facts I am forced to conclude that from a sanitary point of view the combined system of sewerage is a failure.

I visited in London the sanitary department of the Local Government Board which has general supervision of the sanitary affairs of England. The Chief Engineer, Mr. Robert Rawlinson, C. E., and the principal medical inspectors, Dr. Ballard and Mr. Radcliffe, are perfectly agreed that the combined system of sewers is radically defective from a sanitary point of view. In this opinion Dr. Richardson and other prominent sanitarians concurred. At the meeting of the British Association for the Advancement of Science, in York, the leading civil engineers whom I met had abandoned their belief in the "combined system" of sewers, being convinced that it could not be made healthful.

While all were agreed as to the failure of the "combined system," some of the medical men favor the general introduction of the "pail system" of Manchester of "dry removal" of the excreta in tubs, and the use of sewers entirely disconnected from dwellings, to carry off only waste and storm-water; while Mr. Rawlinson and other engineers advocated water carriage by the "separate system."

Separate System of Sewerage.

This system provides for carrying off waste-water slops, and excreta by drains and sewers into which storm-water is not admitted. Since the sewerage to be taken from thickly inhabited areas is only about

one-fiftieth of the rain-fall to be provided for, it follows that sewers to carry sewage only may be very much smaller than those of the combined system. In fact these sewers consist mostly of six, eight, and fifteen-inch glazed pipe. They may run nearly full for a large part of the day. The main fifteen-inch sewer of Memphis runs three-fourths full at 11 A. M. The sewers being so small and so well filled by the flow of sewage, there is very little exposed wall surface on which bacteria can germinate, and very little space for storing up germ-laden air. The gases and heat of decomposition, which so powerfully stimulate the growth of organic life, are prevented by thorough daily flushing, which is only possible in small sewers. The smooth glazed surface of pipes is unfavorable soil for vegetable growth, compared with porous bricks moistened with sewage.

It will therefore be seen that the separate sewers do not afford those favorable conditions for an extensive and rapid growth of bacteria, *which are the fatal defects of the large combined sewers.* The smaller pipes move rapidly all sewage from dwellings, without connecting them with foul caverns *whose sides produce low organic life.* Where the separate system, with flush tanks, is in operation I can learn of no complaints of "sewer gas."

The "separate system" is therefore greatly to be preferred for sanitary reasons.

It remains then to consider whether there are engineering or economic difficulties which should prevent its adoption.

The principal engineering objection to the separate system was that small pipes would be liable to constant obstruction, either from large sticks or other bodies getting into them, or from accumulations of grease. It was also objected that they would not drain the cellars, and that the automatic flush tanks would get out of order.

In practice these difficulties have either proved imaginary or have been overcome. Grease does not enter sewers as grease, but is deposited in the house drain, within a few feet of the kitchen sink.

Obstructions from foreign substances have been so rare, and so easily removed, that they prove of little practical importance, the reason being that most bodies which are small enough to pass through traps and four-inch house drains will not probably stop in six-inch sewers. In Memphis, a city of 35,000 people, thirteen cases of stoppage in the six-inch pipe occurred in the first year of use, but no instance of stoppage in eight-inch pipes. The drainage of cellars and subsoil has been most effectively accomplished in Memphis by laying a system of ordinary agricultural drain tile in the same trench with the sewer; and the Field flush tanks have been found to work well even at low temperatures, and to effectually flush the sewers every day.

There are in fact no engineering difficulties with the separate system that have not been easily overcome.

In discussing the economy of the separate system it will be necessary to consider its application to three classes of towns:

First, towns in which the rain-fall is easily led off on the surface to natural channels of outflow, no system of sewers for storm-water being needed. This class doubtless comprises the great body of towns in the State of New York. For these places a system of *small sewers will cost from one-fifth to one-third the sum required to build a combined system.* The estimates for a combined system in Memphis were from $800,000 to $2,225,000; the actual cost of the separate system was $187,000.

The second class includes those towns which require short storm-water sewers to lead the rain-fall to natural channels of outflow. The building of a comparatively small amount of large storm-water sewer, in addition to the separate sewerage sewers, will not generally make the total expenses equal to that of a combined system. In many places detached sewers already exist for the purpose of freeing certain parts of the town from storm-water, which serve this purpose well, while they are utterly bad for conducting sewage. For such towns the separate system of sewers will be most economical.

The third class comprises a few large cities where an entire system of storm-water sewers are needed in addition to a small system for carrying sewage only.

When the whole drainage is designed and executed from the beginning on this plan, the expense of a complete double system will be probably twenty-five per cent greater than that of the combined system; but the cities where this will be required are generally able and willing to secure healthful arrangements at a small additional cost.

Those cities which have already spent large sums in completing combined sewers must either continue to suffer from the evils of sewer poison, or incur the further expense of a separate small system for carrying sewage only, retaining the large sewers for storm-water.

Hence it appears that for the great majority of towns, which easily get rid of storm-water in gutters, short drains and natural channels, *the cost of the separate system of sewerage will be less than half that of the combined system.*

Although a number of English towns have wholly or partially adopted a separate system, and the results have been so good that the engineers of the Local Government Board advise its general use, yet I was informed by the Chief Engineering Inspector, Mr. Rawlinson, that nowhere in England had the separate system been so completely developed and applied as in America, in the city of Memphis. He

assured me that English engineers and sanitarians were watching with great interest the working of the Memphis sewerage, considering its results to be a thorough test of the principles involved.

On further investigation of the small sewerage plans of Oxford and Dover, which I visited, and other English towns where modifications of the separate system are in use, I was confirmed in the opinion that the separate system of Memphis, designed by Col. George E. Waring, Jr., is much the most thorough and complete which has yet been built on a large scale. Instead, therefore, of describing imperfect English examples of the system, which, although great improvements over the combined sewers, are inferior to the American plan, I shall give the results of a recent examination of the Memphis sewerage, made for the city of Baltimore by Mr. C. H. Latrobe, C. E., a copy of whose report to the mayor and city council I have just received. I regret that I can only quote a very small part of his excellent paper. He says: —

"Having recently examined personally the Memphis system, I give below a description of the same: As is known to your Honors, the city of Memphis is situated immediately on the Mississippi river, and contains a population of 35,000. The fatal epidemics of 1878 and 1879 made it necessary to take decided measures for draining and sewering the city, and abolishing the 7,000 cess-pools which had contaminated and poisoned the soil. In 1868 Mr. Charles Hermany made an exhaustive estimate of the cost of sewering Memphis with the combined single system, and presented several plans, varying in cost from $800,000 to over $2,225,000, depending upon the amount of storm-water to be accommodated. As the excessive cost of these plans, in the impoverished condition of the city, effectually prevented their adoption in 1879, something more economical had to be devised. In this crisis Col. Waring was consulted, and advised the adoption of the separate system for the disposal of the house sewerage alone, through impermeable pipes, common tile drains to be laid in the same trench for the drainage of the sub-soil, and the storm-water to be permitted to flow on the surface into the nearest water-course. After considerable opposition this plan was adopted, and on the 21st of January, 1880, the work was actually begun. The system is based upon a flow of about forty gallons of sewerage per head per diem. The main outlet sewer is twenty inches in diameter, and built of brick; all the other sewers of burnt and glazed clay pipe, ranging from fifteen inches to six inches in diameter, the latter being the size adopted for nearly all branch sewers. At the dead end of every branch sewer is placed an automatic flushing tank with a capacity of 112 gallons. Each tank is filled from the city water supply through a pipe and spigot so arranged as to flow continuously with a sufficient stream

to fill this tank in twenty-four hours, or oftener if desired. As soon as this tank is filled to the proper height, a syphon comes into play, the tank is rapidly emptied into the head of the sewer, and thus prepares itself for another charge of water. There are, at this date, over twenty miles of sewer and one hundred and twenty-five flush tanks at work in Memphis, the total cost of which, including expenditures of all kinds, has been about $137,000, or $685 per mile. The system is now being extended so as to take in the entire area of the city. Of the 7,000 cess-pools, 5,000 have at this date been emptied and filled with clay, whilst the others are being filled as rapidly as possible. In my examination of the Memphis sewerage, I was accompanied by Major Humphreys, the engineer in charge, who is thoroughly acquainted with every part of the work. I first examined the flush tanks placed at the extreme ends of the branch lines. They fill and discharge with the most perfect regularity; there are literally no moving parts, and their extreme simplicity is manifest. They consist of a brick chamber built on a concrete bottom of any size designed (those in Memphis being forty inches in diameter), set below the level of the street, and covered like an ordinary man-hole with a perforated cover; in their center stands an annular syphon four inches in diameter. A three-quarter inch pipe near the top admits the city water, the flow being governed by a spigot. When the tank is filled to the top of the syphon the discharge takes place with a rush, the entire body of water (one hundred and twelve gallons) being discharged in from forty to fifty seconds. It first runs into a box under the syphon, and from thence into the sewer-head. As soon as the tank is emptied by the main syphon, its lower end is unsealed by a small subsidiary syphon, and the process of refilling the tank begins. The only drawback to the perfect action of these tanks has arisen from the muddy character of the city water, which may be appreciated from the fact that a half-gallon pitcher will deposit during the night one-half inch of solid mud. This muddy deposit sometimes clogs the action of the subsidiary syphon, which has a bore of only one inch. This difficulty has been obviated at Memphis by washing out the small syphon say once a week, with a small hose about three feet long put on the supply pipe of the tank — a process which takes about ten minutes. One man attends to and keeps in order the entire lot of flush tanks, one hundred and forty-five in number, without difficulty. The grade of the branch sewers, which are connected directly with the flush tanks, varies from six inches to three inches in the hundred feet; and the rush of water from the tanks is distinctly felt at a distance varying from four hundred to nine hundred feet, keeping the pipes perfectly clean. No tendency to freeze has been noticed in the tanks, although

the temperature has been as low as four degrees the past winter. These tanks are a patented article, and the city of Memphis paid ten dollars per tank for the privilege of building and using them. The total cost of a tank ready for use is forty-five dollars, exclusive of royalty. I should say from observation that these tanks fulfill admirably their purpose, are thoroughly automatic in their action, and require very little attention. Whenever it is practicable, the branch sewers of Memphis are located on alleys in the rear of the houses, so as to avoid the cutting of trenches in the streets. With the small sewers of the separate system this is perfectly practicable, and prevents the necessity of carrying the house soil-pipe to the front of the house.

"I next gave a close inspection to the condition of the main and outlet sewers, both to the fifteen-inch pipe and twenty-inch brick sewer. This was readily done, as it had been found expedient to break into the crown of the main at several points for the purpose of constructing man-holes. At the time of my inspection (11 A. M.), the sewers were running three-fourths full with a swift current. Nothing solid of any sort was to be detected in the flow, even by dredging; an occasional piece of paper constituting the only undissolved matter; every thing was in solution, and the sewerage was about the color and consistence of the Mississippi river water. Although in several places the entire crown of the sewer had been removed, it was difficult to detect any odor until you were within two or three feet of the flow. Major Humphreys stated this was the uniform condition of the mains, and that the ventilation seemed perfect. I would state in this connection that the main house-pipe is required by law to be four inches in diameter, and to connect with the sewer without a trap, its upper end is then carried above the roof of the house, full size, and left open; every water-closet, kitchen-sink, bath-tub and waste-sink connects with this four-inch pipe by a trap connection of its own. The varying height of the four-inch house-mains, together with the constant flow of sewage, stimulated by the intermittent discharge of the flush tanks, keeps the whole system well ventilated and in perfect order. The main and outlet sewers have an inclination of from one in four hundred to one in six hundred feet, and the sewage is finally discharged into Wolf river, near its confluence with the Mississippi. To assist the ventilation and afford means for inspection, it was originally intended to place a fresh-air inlet at every junction of a lateral sewer with the main; this is so arranged as to let in air and keep out dirt, and is covered with a grating. I found that out of forty provided, only nine had been used from this belief that they were unnecessary. The only deposit which has ever been noticed in the mains is a fine silt of moderate tenacity, supposed to be a mixture of the mud

held in solution by the river water, combined with the pulp of dissolved paper. This readily washed out by passing the ball through the mains from man-hole to man-hole. A hollow ball of galvanized iron having an inlet and stopper, and about three inchess less in diameter than the sewer is charged with water sufficiently to keep it in contact with the roof, along which it rolls; it is then dropped into the sewer at a man-hole, the current instantly gorges, and rushes under the ball with great velocity, and scours the bottom of the sewer, the ball in the meantime rolls along the roof of the sewer, and is stopped, if desired, at the next man-hole, and taken out. Balls of different sizes are used as desirable. The above-mentioned deposit or silt in the mains has never been more than from one inch to one and a half inches in depth. The only obstructions which have occurred (thirteen in number) in the branch pipes during the twelve months in which the system has been in use have invariably been occasioned by sticks about six inches long getting across the pipe. The obstruction is immediately located by the rising of the sewage in the yard waste-sink of the house just above it. The sewer is then uncovered at the proper place, cut open on top, and the obstruction pulled out with a hook of twisted telegraph wire. This would seem to indicate that any slender article, not over six inches long, will pass through a four-inch trap; this is further proved by the fact that a number of two-feet carpenters' rules, which fold to six inches, have been taken out of the sewers. This being so, the remedy would seem to be either to use no pipe less than seven (7) inches in diameter, or to arrange the traps so as not to pass six-inch sticks. No obstruction has ever taken place in the eight-inch or ten-inch pipes, or in the twelve-inch, fifteen-inch or twenty-inch mains.

I understand, from Major Humphries, that not a single case has occurred of the breaking of the pipe. The drainage of the sub-soil by common agricultural drain pipes, from one to three inches in diameter, is excellent. They are laid along side of the sewer pipe in the same trench, and at the proper points are carried off to empty into the nearest water-course. Now, as to the house arrangements, the regulations are stringent, no plumbing is allowed on any plan but that adopted by the authorities and carried out under a rigid inspection by the engineer, and no house is permitted to connect with the sewer until inspected and passed. Every outlet for waste is connected with the four-inch house pipe and trapped; a slop waste is insisted on for each house, so that nothing is thrown into the gutter or on the soil. No pan closets or Brahma closets are allowed where there is an air space between the trap and the pan; the use of some form of hopper closet is preferred. All connections with sewers are made by **Y**'s and not by **T**'s.

"The city lays a branch every twenty-four (24) feet to the curb; to this the householder joins his iron four-inch house pipe. This avoids tearing up the street to make house connections.

"There has been to this date no complaint, in so far as I could find out, of sewer gas, and I cannot see how there could well be with so constant and rapid a flow of sewage, thoroughly dissolved, as was plainly visible in the mains. I learned from a prominent citizen and householder that the only inconvenience he had ever experienced arose from the breaking down, temporarily, of the water-works, which are on the Holly system, and which at the time depended on a single engine; for a few days he could not use his closets for want of water.

"By gaugings taken at the head of the twenty-inch mains I found the hourly flow of sewage to be remarkably uniform. Thus, from 6 A. M. till 1 A. M. the following morning, a period of twenty hours, the flow oscillated in centre depth from twelve and one-half to fourteen and one-half inches, the minimum area of flow being 206.5 square inches; the maximum, 245.73 square inches. From 1 A. M. until 5 A. M., a period of four hours, the center depth of flow varied from eight and one-half inches to eleven and one-half inches; minimum area being 107.6 square inches; maximum area, 186.9 square inches. Taking the twenty-four hours, the minimum flow is 43.7 per cent of the maximum; taking the twenty hours of greatest flow, the minimum is eighty-four per cent of the maximum, and eight-ninths of the daily flow of sewage passed in twenty hours, one-ninth in four hours. This marked uniformity of flow during twenty hours of the day, and its oscillating character within such small limits must be somewhat influenced by the action of the flush-tanks, which probably discharge in small groups.

"The force employed in maintaining the sewers alone and its cost I could not obtain accurately, as they were doing much other work with the same men; but, approximately, a force of four men watch and keep in order the entire system, including the flushing tanks, house visitations, etc. All the work at Memphis has been admirably and faithfully done under the immediate supervision of skilled engineer assistants.

"In summing up my impressions as to the separate system as developed at Memphis, I would say that it is well planned and well executed, and fully answers the purpose for which it was intended and which I conceive to be primarily the object of all sewerage, viz.: to carry off all human and industrial waste with rapidity and cleanliness to its ultimate destination.

"The accompanying system of tile drains has also thoroughly drained (as far as I know) the very tenacious sub-soil of the city. As to the

storm-water at Memphis, it can safely be left, from all I learn, to take care of itself.

"The errors or omissions in the Memphis system are:

"*First.* Insufficient size in the mains to accommodate the excessive use or waste of water during severe winters, when people allow spigots to run all the time, to prevent freezing. During the winter just ended, Major Humphreys estimates that one hundred gallons *per capita* per day were often used which caused the mains to run full bore, and occasioned a backing up of the sewage in the lower parts of the city. This fault, of course, was not incident at all to the system, and was an oversight in proportioning the mains, and would not be felt during an ordinary winter.

"*Second.* The omission of man-holes in the mains, as well as means of opening the small pipes without breaking them, to remove obstructions which will sometimes occur. These omissions are now being remedied. Man-holes being constructed at every five hundred feet on the mains, and when a section of small pipe is broken into, it is replaced by a T shaped section, with a lid on the top, of the upright stems of the T, which can be readily removed and the cleaning tool introduced. When these improvements are made, the system will be very complete. The want of size in the mains, should it become an annoyance, can only be remedied either by duplicating them or rebuilding them on a larger scale. I think an error has been made in not using the fresh-air inlets, as originally intended, at the junction of branch sewers with the mains. They are useful for ventilation and observation."

CONCLUSION.

In obedience to the resolution of this Board I have endeavored by the examination of foreign and American experience to determine what method of sewerage we ought to recommend to the towns and cities of this State applying for advice. I am convinced that both in England and in America large, combined sewers for carrying storm-water and sewage are and necessarily must be constant and powerful sources of disease; and that for most towns, they are a very costly method of removing sewage.

I am of the opinion that the separate system of small sewers avoids in great measure the inherent sanitary difficulties of the combined plan; and that it is an efficient and economical method of removing the sewage of towns. I therefore recommend the State Board of Health to advise the adoption of the separate system of sewage in those towns which have asked for information on this subject.

Respectfully submitted,

JAMES T. GARDINER.

Chairman of Committee on Drainage, Sewerage and Topography.

At the quarterly meeting of the State Board of Health, held at Albany, February 8, 1881, Mr. Jas. T. Gardiner, one of the members of the Board, and chairman of the committee on drainage, sewerage and topography, presented statements supplementary to his report on sewerage of the smaller cities and large villages, as presented to the Legislature in the Board's second annual report, setting forth urgent reasons for the adoption of the "separate system" of sewerage, with daily flushing.

The following preamble and resolutions were adopted by the Board and ordered to be published:

WHEREAS, Many cases of disease directly traceable to contamination of water and earth by the soakage from privies and cess-pools have come within the knowledge of this Board; and

WHEREAS, Disease from this cause will continue to increase more and more rapidly unless action is taken to avert the evil; therefore be it

Resolved by the State Board of Health:

1. That the use of privy vaults, privy-pits and cess-pools is seriously affecting the public health.

2. That all excreta should be removed from the neighborhood of human dwellings instead of being stored up near them in pits, vaults or pools, to poison the water, earth and air.

3. That in villages and cities this removal of excreta should be done by the local authorities, who shall be responsible for its proper performance, and in isolated localities by the individuals interested.

4. That this removal of excreta may be cheaply and healthfully done either by "dry-removal" or by "water-carriage."

5. That we recommend the method of "dry-removal, called the tub or pail system," as the best for villages, hamlets and isolated dwellings which are without water supply, or have not the means to build sewers.

6. That towns having proper water supply should be provided with a system of small sewers adapted to carry only sewage, including excreta, slops and waste-water, and excluding storm-water, which should be taken care of separately.

7. That the costly plan of large combined sewers, for carrying sewage and storm-water *together*, has proved a sanitary failure both in England and in this country; while the "separate system," when properly constructed, avoids in great measure the evils from sewer-air, now so common, and is much less expensive for most towns.

8. That the "separate system of sewers," with flushing tanks, is hereby recommended for general use in this State.

Published and distributed in answer to requests for information.

By order of the Board,

ELISHA HARRIS, *Secretary.*

REPORT OF THE COMMITTEE ON EFFLUVIUM NUISANCES.

On the 6th of January, 1881, a memorial from citizens of the city of New York praying the Governor to require the State Board of Health to investigate and report upon stench nuisances at and near Hunter's Point, was transmitted by Governor Cornell to this Board.

The Memorial of Citizens: — The following memorial, signed by Messrs. Howard Potter, Charles P. Daly, James Gallatin, Alfred C. Post, M. D., C. R. Agnew, M. D., and one hundred others, was presented to the Governor, and by him referred to the State Board of Health

To Hon. ALONZO B. CORNELL, *Governor of the State of New York:*

The undersigned, residents of the city of New York, beg leave to call your attention to certain things which in their judgment constitute a nuisance affecting the security of life and health in this city; namely, the noisome and offensive smells, generated either at Hunter's Point and other places on Long Island by agencies unknown to your petitioners, which are brought into this city by winds and other natural causes; or else arising from the carrying on of offensive trades in the said city.

Your petitioners represent to your Excellency, that the local Board of Health of this city has failed to procure the abatement of this nuisance, and that the same is in their judgment a proper subject for examination by the State Board of Health under the requisition of your Excellency, pursuant to the act of the Legislature known as chapter 322 of the Laws of 1880.

Your petitioners respectfully ask that your Excellency require such examination.

Dated NEW YORK, *December*, 1880.

At the quarterly meeting of the State Board of Health, at Albany, February 9th, 1881, the above memorial, signed by 105 citizens of the city of New York, was referred to a committee by the following resolution:

Resolved, That a special committee be appointed by the chair to proceed to New York city to take testimony with regard to the nuisances alleged to exist there in the petition of citizens referred to this Board for examination by the Governor, under date of January 5, 1881, and that this committee be authorized to employ a stenographer, and such experts and agents as may be necessary to complete the investigation. That the memorial of citizens, with the reference of the Governor, be

referred to this committee, and that such special committee report to this Board the evidence taken with their conclusions thereon, with all convenient dispatch.

The three State commissioners were appointed to be such committee for this investigation: Dr. J. Savage Delavan, chairman, Hon. Erastus Brooks, and Dr. Elisha Harris.

PRELIMINARY STEPS.— After several public hearings by the committee in the city of New York; and after personally inspecting all places known or suspected as sources of the nuisances complained, such expert services as were deemed necessary in certain chemical investigations* were engaged; while in its proceedings the committee had the advantages of the testimony and recent records of the health authorities in Brooklyn and New York, and also had its own memorandum of information carefully arranged for practical uses.*

On the 15th of April the committee transmitted to the Board a report of its proceedings and conclusions; and, on the 16th, the Board adopted said report and ordered it to be presented to the Governor.

REPORT.

To the State Board of Health :

Agreeably to the appointment of the President of the State Board of Health at its meeting, February 9th, 1881, the special committee on "effluvium nuisances," proceeded to New York to take testimony from those petitioners who had made special complaint to His Excellency, the Governor of the State, concerning such alleged nuisances, due notice having been given to each petitioner. The committee held three sittings at No. 79 Fourth avenue, at the rooms of the Association for Improving the Condition of the Poor, on February 23d, and 26th, and March 3d.

The testimony taken at these hearings of your committee, both from those petitioners and others who were present and personally gave evidence, as well as the written testimony in answer to certain questions received by the committee while in session, is presented in full, with this report. After this testimony had been duly considered, the committee made a tour of inspection and investigated the sources of the nuisances complained of, on the 26th of March. They have also caused special investigations to be made by experts, both as regards sequestered nuisances; and also concerning the chemistry of stenches, as understood at the present day. They herewith present their report to the State Board of Health, together with an abstract of the testimony taken, a special report of a chemical expert, also the conclusions reached after due consideration of the testimony and the results of their official visit to the localities and industries complained of.

J. SAVAGE DELAVAN,
Chairman of Committee.

---

* See abstracts of papers appended to this Report.

The special committee for investigating stench nuisances has listened to, and recorded, a large amount of voluntary testimony, and so far as at present informed, the members of this committee are unanimously agreed that offensive odors are frequently noticeable over a great extent of the districts of the city of New York, and that they are borne upon the atmospheric currents from the south-eastward crossing the East river, and not unfrequently, as far westward as Broadway and 6th and 7th avenues. Mr. Frederick Law Olmsted, whose testimony is of the highest trustworthiness, states that the stench nuisance from the south-eastward is borne to his residence in 46th street, between 7th and 8th avenues.

The voluntary testimony thus far taken presents a certain number of points and some conclusive testimony respecting the effects produced upon those who complain of the odors and of the necessity which they create, wherever smelled, for the closing of doors and windows on the windward side of their houses. The committee regard this as good and substantial evidence that the nuisance complained of is a nuisance against health. No effort need be made to find what particular disease has been produced by any such nuisance, the effect upon the nervous system, and the disturbance of the comfort and mental peace of individuals in vast numbers of families, who are helpless to defend themselves in any manner without removing far from their present residences, are facts well proven. The committee would attach great importance to this fact, and allow it to stand by itself, as others are being settled by the evidence received.

The localities from which the greatest number of complaints and the most emphatic and well defined statements concerning these stench nuisances come must be regarded as important. Thus far they have been chiefly between 38th and 59th streets, on the East river side, and as far westward as 7th avenue.

The following abstract of certain points in the volunteer testimony taken by the committee comprise: *First.* Points upon which all agree, among upwards of one hundred who testified by written statements. *Second.* Verbal testimony, given in response to questions by the committee.*

THE WRITTEN TESTIMONY.—All agree in their answers concerning the nature of the stenches that kerosene, sludge acid, or sludge, putrid animal odors, ammoniacal sulphurous gases, or vapors are oftenest noticeable; that in the city of New York these odors seem to come from the eastward and south-eastward; that they are noticeable across more than half the width of the city, from eastward to westward; that they vary in intensity greatly at different parts of the day, and on different days, but are smelled at all hours, though most at evening; that they cause nausea, and that numerous persons are made sick in consequence; that invalids and feeble persons suffer most.

The committee quote from the numerous written statements the following, which illustrate quite correctly the whole:

Dr. C. R. Agnew, whose family residence is at 266 Madison avenue, corner of East 39th street, writes that his family suffers at all seasons, and at all hours when the wind is from the right quarter, east or south-east; that the odors at his house are most noticeable at his front win-

*An abstract of a memorandum which was prepared in committee, to facilitate its work, is appended to this report marked [A].

dows and doors; he would term them kerosene smells; that "they are sources of sickness by causing windows and other ventilators to be closed, and by their depressing effect upon health, and by unpleasantly affecting the nervous system in various ways." He further testifies that "a bad stench is a source of disease, because in many ways it vexes the nervous system of sensitive people."

Dr. Thomas F. Cock, whose residence is at 14 East 40th street, between Fifth avenue and Madison avenue, testifies: The stenches are noticeable all over Murray hill when the wind is from the south-east; they are traceable to the region of Hunter's Point; that they aggravate sickness and affect all persons of cleanly habits; that during his summer travel upon the Long Island railroad, several distinct sources of stenches are recognizable and are excessively offensive.

Dr. J. L. Higgins, of 23 Beakman place, opposite Hunter's Point, testifies: That in his locality the odors create an increased sickness; "frequently," he continues, "I have had to leave my house and go to another portion of the city for temporary relief where supportable air could be found; in the summer we have to close all the windows at times and exclude the odors."

Dr. J. M. Hills, of 438 Madison avenue, testifies: That in the region of his residence bad odors are noticeable at all times of the day; that they are most intense from 30th to 50th streets, from the river side to Madison avenue; that the odors "are intensely disagreeable and suffocating."

John M. Drake, Esq., of 4 Beakman place, near East 48th street, testifies: That the odors are most offensive afternoons and evenings, and at the west side of the dwellings; that the "smells are those of 'sludge,' phosphates, and slaughter-houses, of which there are several in this immediate vicinity.

Dr. J. D. Trask, Astoria, testifies: That the stenches are noticeable at all hours; that his residence suffers most when south and south-east winds prevail; that the smells are sickening; that they cause and increase sickness; that his wife, sons and daughters alike testify to these facts.

J. H. Montgomery, Esq., of 13 Prospect place, East 41st street, testifies: That the odors are intense at his place of residence, and westward as far as Fifth avenue, to his certain knowledge; that "the smell is like decomposing matter and *offal stench*," which "must be smelled to be appreciated;" designates them as coming from fat-rendering and fertilizer factories; that he is not only compelled to close his windows against suffocating stenches, but has been broken of rest night after night; that they cause sickness most emphatically.

Signor Mendelshon, residing at 2 Prospect place, East 41st street, testifies. That the smells seem to come from Hunter's Point, petroleum refineries, and from fat-rendering establishments; that the stenches are sickening and foul, reach his residence from the east; that they cause nausea and an inclination to vomit; that they produce sickness in his family; that in summer they are most offensive and compel people to keep their doors and windows closely shut.

Dr. Buttles, residing at 28 East 28th street, near Fifth avenue, testifies: That the stenches from the east reach that part of the city at all seasons, and at any hour of the day or night; that they are offensive the whole distance from 23d to 90th street; that they are disgusting

and sickening; that cases of sickness are often traced to this cause. The doctor gives the names and residences of those patients who have suffered sickness from this cause in the region of the city here mentioned.

Dr. L. Bolton Bangs testifies: That the stenches are noticeable at 23d street, and far northward; that at times they are intolerable; that they are worse with an east wind; that they cause nausea and headache, and an extreme sense of suffocation; that they increase prostration in those who are sick, and are especially injurious to patients sick with fever or any lung trouble. The doctor gives names of sufferers.

Mr. E. Tatum, residing at 244 East 15th street, near the Friends' schools and meeting-house, testifies: That there is greatest suffering in that region at low tide, when the winds are easterly.

Dr. John C. Peters, residing at 83 Madison avenue, near 29th street, testifies: That these stenches are most noticeable from 23d to 50th street, on the eastern side of the city, and as far westward as Fifth avenue. He testifies that ladies are made wretched by the stenches; that they are waked up from sleep by them; that they undoubtedly cause sickness. He gives names and residences of a number of sufferers living in the region here mentioned.

Dr. Hitchcock, of 8 Beekman place, above East 48th street, testifies: That the violence of the stenches is indescribable; that they are most apparent when dense volumes of black smoke issues from the oil refineries; that they reach his residence from the east and south-east, blowing directly across Murray hill; that they produce sickness and depression in him and in many of his neighbors; they also cause sickness — not specific diseases and fevers — but sickness.

Dr. Estabrook, chief of staff of the Charity Hospital medical service, testifies: That the odors are noticeable at all times and seasons when the southerly winds prevail. The hospitals of which he has charge are directly north from Hunter's Point and Newtown creek. He adds "that the stench coming from Hunter's Point is often so charged with acid fumes as to be exceedingly irritating to the lungs and throat, and to compel the closing of doors and windows during hot days.

George D. Bleything, residing at 175 East 78th street, testifies: That at his house great suffering is experienced from the stenches when the wind is from the south or from the south-east; that they are compelled to close their southern windows, even in the most pleasant weather, to shut out the nauseating odor.

Dr. Charles Milne, residing at 144 East 45th street, testifies: That the stenches produce sickness, especially in children, and in all invalids to whom fresh air is most essential.

Dr. W. H. Hall, of 129 East 54th street, testifies: That he traces sickness in numerous families to the stenches; that these stenches are "active factors in generating disease."

Dr. Andrew H. Smith, of 22 East 42d street, testifies: That these stenches afflict the whole east side of the city above 23d street; "at times they are suggestive of petroleum, at other times of rancid, putrifying fat;" they proceed from the direction of Long Island City; that they cause nausea, headache; that they impair appetite; injure persons of delicate stomach; aggravate diseases of debility; that they have often wakened him out of a sound sleep during a sudden change of wind which brought them into his open sleeping-room.

Dr. Albert H. Buck, of 109 Madison avenue, near 30th street, testifies: That the smells consist of "sickening odors penetrating every part of the house;" they are always eastward; they are injurious to infants and delicate persons.

Mrs. J. M. Fisk, residing at 999 Fifth avenue and 70th street, testifies: That the stenches are most oppressive at her residence in the afternoon; that they seem to come from the petroleum and the bone-boiling works from across the East river; that at times the house is suddenly pervaded by them; that they cause sickness; compel closing of windows.

THE ORAL TESTIMONY.— In language like the foregoing the complainants have voluntarily given testimony in writing, while the verbal testimony has been given in the presence of the committee in terms even stronger, in connection with many details, which, taken at a justifiable estimate, are valuable and significant, certainly, leaving no doubt as to kinds and degrees of sufferings experienced by many of the inhabitants in the central districts of the city of New York.

The total number of persons whose testimony is given in their own handwriting is fifty-eight, and the number who appeared voluntarily and gave verbal testimony, which was stenographically reported and has since been written out in full, is thirty-one. This body of evidence is available for future use, but is not here presented.

Names or designations given to the stenches complained of.

Sludge-acid, or sludge, sulphuretted gases, stinking gases, petroleum smells, putrid odors, ammoniacal gases, fat-house smells, offal rendering, bone-boiling, bone-burning, superphospate fertilizer factory stenches, manure heaps and manure dumps, are the designations given in testimony. The name of the spent, or waste, acid, known among the people as sludge acid, has become most common in the mouths of complainants. This is natural, for it appears from the records of proceedings against fertilizer factorics, during the past several years, under orders from the Board of Health of the city of New York, and under orders from the Board of Health of Brooklyn, that the intensest nuisance is caused by this waste acid — a resultant of the process of the agitation of sulphuric acid with the distilled kerosene. It has been proved to be the most intense and persistent of the stenches, and it has become widely known by common repetition and disrepute of its name, but is often, as the committee believes, applied quite indiscriminately to the total of stench nuisances observable on the high grounds of the central district of New York city. Other stenches as described, and as quite conclusively verified by the committee under its own inspection, as well as by special testimony which came from experts who have had an opportunity of acquiring a correct knowledge of the nature of the nuisances complained of, may be correctly mentioned in the following order:

1. Offensive odors of putrescent animal matters in the nature of offal, putrid fish, and fish-scrap, as well as all other animal scrap in a moist, putrescent state.

2. Gases and effluvia resulting from the contact of sulphuric acid, pure or impure, with such materials and other phosphatic matter, as witnessed in the superphospate factories.

3. Gas and vapor arising from cooking or burning of fatty animal matters, whatever the process may be, especially the bone-boiling and offal rendering as witnessed on Newtown creek near Hunter's Point.

4. The escape of vast volumes of unconsumed smoke from whatever sources, where oily and fatty, tarry or any kind of animal or offensive organic matters are being partially and unskilfully burned, and allowing the escape of smoke and vapor into the atmosphere, unconsumed and unneutralized, as seems to have been witnessed from the beginning of these complaints, in connection with almost every kind of refinery where these substances are undergoing distillation or vaporization by heat. The open exposure of offal and other putrid matters, and the slovenly manipulation of common manures and fertilizers as witnessed upon the New York side as well as upon the Hunter's Point side; the running of offensive waste materials into the affluents of the East river, and even into this river itself, which has been going on for many years until a deposit of vile mud and sedimentary matter and slime is now smearing many miles of the tidal banks of Newtown creek and its estuaries, as well as some portions of the East river side, and not a few of the sewer outlets and the slips and docks.

5. Temporary and apparently surreptitious attempts to manipulate the sludge acid and other matters that produce foul and far-reaching stenches at various points along Newtown creek; the neglect of proper rules and regulations for the stoking and maintenance of furnace fires in connection with nearly all the establishments that are accused of these nuisances; the exception to this neglect being of quite recent date, and in the few larger works as witnessed in the kerosene establishments that have succeeded in overcoming this evil.

This series of stenches, and these causes of them, have acquired a magnitude that can hardly have been witnessed elsewhere in the world; for the businesses with which they are connected are, with few exceptions, conducted upon an enormous scale. The kerosene works illustrate this fact, so do the superphosphate manufactories and the restoration of sludge-acid works. Therefore, the whole subject possesses an importance which the petitioners to the Governor have not overrated in their memorial.

Identification and description of them.

A few of the witnesses who have borne voluntary testimony have confidently asserted that they smelled at various times odors that they could specify. This may have been true in their experience — the stenches from burning fats and bones, from superphosphate factories and the sludge vapor, from petroleum stills and from gas house purifiers, are separately distinguishable. Yet where numerous vapors and gases are combined as they float in the atmosphere, it cannot be considered necessary in establishing the fact relating to nuisances, that each of the polluting agents in the air shall be positively identified and separately named. It would be asking too much. The committee's personal observation, and the testimony of the most trustworthy of the witnesses alike establish the fact that most of the sickening and offensive vapors that are smelled in the vicinity of Hunter's Point and on the New York side, opposite, are *combined* effluvia which should be accredited to sev-

eral causes that are in operation at the same time. There is no doubt, however, that there are certain odors and odorous vapors which are much *more persistent* and which *float farther* than others, undiminished or undestroyed as respects their offensiveness and character as stenches. The evidence seems conclusive that this is true of naphthous and certain other special vapors from petroleum oil under treatment by heat or by acids, and such stenches are doubtless as infinitely variable and combined as their chemical changes and characteristics are. It seems to be equally true that the offensive odors from putrid animal matter, and the vapor from the rendering of fats and from bone-boiling and bone-burning establishments, are readily conveyed long distances by the atmosphere with all their pungency and sickening odor. Ammonia and sulphuretted hydrogen, of course, are not conveyed to any great distance; for, as their chemistry proves, they are rapidly absorbed by moisture, and thus diluted and combined and at last rendered imperceptible to the senses. Yet these are offensive enough in the neighborhood where produced, as was witnessed in the vicinity of the Standard Ammonia Works, visited by the committee.

The most pungent and suffocating of all effluvia smelled by the committee, or complained of by those who have testified, are those from sludge-acid and from the superphosphate establishments.

According to the testimony of Prof. Nason, and from what the committee judges to be true from its own examinations of the establishments, the heated vapors which hitherto — until quite recently at three or four of the kerosene works — have been given off during the process of "blowing out" and cleansing of the great petroleum stills (of which there are a hundred or more in operation, each with a capacity of from 300 to 600 barrels) produce the most far-reaching and intense of the effluvia connected with the kerosene works. The Empire, the Standard and the Pratt Astral Oil Works now demonstrate the fact that *this source of nuisance is, and should ever be, completely prevented;* and that by a simple system of hoods and connecting tubes, aided by a suction chamber near the terminus of the collecting tubes, all such vapors are drawn away and blown into a heated furnace, as useful fuel. By this simple and effective process the committee witnessed the control of what was, until recently, one of the chief nuisances of kerosene works.

Alongside the Standard and Empire Oil Works, the mixing and exposure of superphosphate fertilizers is carried on. Near the foot of Eighth street, on the East river, Long Island City, pungent and sickening odors were smelled at a distance of several hundred yards, and were more intense and offensive than all of the odors noticeable about those two largest of the petroleum refineries. The claim that has been occasionally alluded to, if not positively asserted, in the course of the testimony received by the committee, that the commercially pure sulphuric acid used by certain superphosphate manufactories has prevented all nuisance from such exceptionally well-conducted places, does not seem to be well founded; for at one of the largest of these establishments on the Queens county side of Newtown creek, at which it was found that clean commercial acid was being used, of about 55° (Beaumi test), the committee found the atmosphere of the place densely loaded with the offensive effluvia characteristic of the superphosphate manufacture.

Combination of various effluvia.

The committee need only show upon the chart of the nuisance districts how the whole series of effluvium factories and materials is distributed along the lines eastward from the East river, opposite the central regions of New York. Any effluvium that pertains or attaches to heated vapors or gases may be floated westward, eastward, or in any direction, for a considerable distance, whenever the vapors with which it is connected are sufficiently heated to permit the whole to be wafted onward in a given moving stratum of the atmosphere. Under such circumstances it is not *one stench alone*, but necessarily *a combination of all the stenches* that reach and float in the moving current of air, and the question how far they may float onward together seems to have been determined by an unpleasant experience of thousands of inhabitants of New York city. The varying amount and intensity of the effluvium nuisance and of the share which each one takes in the total, are points on which we have no other evidence than that which is presented in the testimony and statements which the committee is now prepared to submit. On particular days in the week, and at particular periods of the same day, the mixing of sulphuric acid or sludge acid with the animal and earthy matter, which constitutes the phosphatic and ammoniacal basis of the fertilizer, may be in full operation, and at all other times no such mixing of acid will be going on. In like manner ammonia factories may carelessly, or by accident, set free great volumes of ammoniacal and sulphuretted vapors, heated or otherwise, from certain parts of their buildings, or at the water-surface, or beneath the surface, as it is undoubtedly, as asserted, a frequent occurrence. In like manner also the manipulating of the sludge, outside of closed metallic tanks by which *the well regulated kerosene works do now control this dangerous nuisance*, will necessarily evolve the terribly disgusting stench that pertains to this substance when in contact with water or moist materials; and, added to all these, there may be, and certainly often are, dense volumes of smoke and offensive vapors evolved from other establishments in the districts in which the stenches are produced. These, taken together, make up the total stench nuisances against which the people are protesting.

This committee feels warranted in the assertion that fully ninety per cent of the total nuisance of stenches complained of is the direct result of needless and culpable negligence, and failure to adopt and enforce suitable rules and regulations, and to introduce well-known approved means for controlling and preventing such nuisances.

Conclusions.

1. *Concerning Refuse and Waste Materials from the Cities.*

All such matters need to be removed as thoroughly and as promptly as possible, for the protection of the health and comfort of the people. The value of the materials themselves requires that this should be systematically done, and done without waste. Animal and vegetable matters in the form of garbage from kitchens, markets and butcheries seem to be imperfectly disposed of, and that which is subject to the processes of rendering, bone-boiling, and bone-burning is not carried sufficiently far away from the built-up districts. The methods of utilizing waste

materials are rude and nasty; there is little effort made to prevent nuisance from this class of substances. The removal and general control of manure from the stables and dumps in the cities have not been subjected to complaint by any of the voluntary witnesses excepting those in the vicinity of Long Island railways, upon which the manure from New York is accumulated. The committee has obtained evidence that the sources of nuisance from the manure of New York, as regards its daily removal and methods of shipment, show that there should be no nuisance wherever publicly complained of, because all these processes are already greatly improved in the regulations put upon them, and can be made inoffensive.

Accumulations of manure upon any docks, or along any passenger railways, as at present witnessed in Long Island City, will need to be prohibited. The question of the more distant and sequestered storage of such material should be promptly settled; not only are the three cities, but millions of people who travel upon the railways and ferries, are interested in this. In like manner, thousands of inhabitants of New York may be needlessly annoyed by any one of the manure dumping and mixing yards, wherein vast quantities remain improperly on storage for months, close by densely populated streets. The whole business of manure storage should be farther and sufficiently away from the cities and all populous neighborhoods, and away from close proximity to great passenger railways, ferries and stations. Local Boards of Health should adopt and enforce uniform and strict rules against this filth nuisance.

The committee can safely express as its own conviction and judgment, that the chief and most noticeable sources and causes of offensive effluvia, whether in the nature of gases, vapors, smoke, or any kind of stench, are found to depend upon preventable kinds of neglect, carelessness, ignorance and nastiness; that some things are, in their very nature and condition of putrescence, so offensive and injurious, that no excuse can be found for permitting them to remain in the presence of any city or populous place any longer than is necessary for securing their promptest removal; that as regards the substances, businesses and methods which can be rendered inoffensive, whatever their possibilities of producing stenches and defiling the atmosphere may be, when neglected or improperly managed, the committee finds it a duty to ascertain what the best experience and evidences are that such offensiveness may be entirely prevented by those who have the management of the same; that what is now found to be entirely practicable in preventing and controlling such sources of nuisance should be fully understood, faithfully enforced, not only by the sanitary authorities, but by the managers of all such materials, businesses and methods; that such causes of nuisance as are not so proved to be manageable and preventable should be removed to a sufficient distance from the population that are helpless to prevent and avoid the stenches, as to cause no offense excepting to those who are concerned in such management and business.

2. *Concerning the Oil Refineries.*

The committee finds that causes and sources of intense and much complained of stenches from petroleum oil works seem to have existed,

for many years past, along Newtown creek and the East river side of Hunter's Point; it has also been proved that, in consequence of persistent pressure brought to bear upon the largest of these oil companies by the Health Board of New York city, these companies have recently begun to institute important improvements both mechanical and adminstrative throughout all their refineries. Scientific and experienced men employed by some of these companies at present concede all that has been asserted regarding the offensiveness of certain products and processes in the refining business. There is good evidence that no small part of the causes of such offensiveness is well understood by the men who manage the refineries. The clearing out and steam "blowing" of heated stills may be quoted as evidence of knowledge and cause of evil which, until recently, has not been controlled. Close hoods and suction conduits are the simple and quite effectual methods now of controlling this source of nuisance, and their adoption at the Standard, Empire and Pratt refineries sufficiently attest the controllability of this evil.

Sub-surface tubular drainage for the recovery of waste oily matters upon the premises of the refineries is proved to be entirely practicable, and this is a source of protection from nuisance and from conflagrations. The greatest and yet the simplest of all the achievements for preventing the nuisance from "sludge," is witnessed in the closed metallic tanks, which are floated near to the refineries for the reception of the foul, sulphuric acid known as sludge. Yet great as this improvement is, and obviously necessary, the committee witnessed the open conveyance of a horse-cart loaded with a huge tank for transporting sludge-acid from some neighboring reservoir of that stuff, and to a still more nasty and wanton exposure of the same in the process of steam-heating, wrongly called *refining*, on the Brooklyn side of Newtown creek. The absolute control of the sludge as fast as produced at the kerosene "agitators;" its removal to suitable distances from the built-up districts before exposing it in the process for the recovery of the sulphuric acid, which is simply the removal of the foul material that it has taken to itself in the great agitating tanks of the kerosene works — indeed, before exposing and manipulating it in any manner — is so plain an obligation of the parties who produce or possess it, that the committee believes it is the duty of every local Board of Health (and if need be, of the State government) to declare a neglect to do this to be a misdemeanor. A small quantity of this abominable material when mixed with water or exposed to vapor or heat in the open air, or when it is being mixed, or stored in a moist mixture with earthy, animal or vegetable matters, sends forth effluvia that ought not to be endured, and must be prevented.

Escape of light oils which are vaporized in various ways and wasted in the atmosphere during the process of distillation, or open exposure of them in various manipulations of the refineries, etc., is all unnecessary and should be prevented. They are not too offensive, perhaps, to be endured, but this is a needless source of nuisance, and has had its share in making up the total of what is known as the oil refinery nuisance. A complete control of all these things is witnessed at several of the refineries already described in the committee's report.

The escape of offensive waste material into the waters or upon the water-sides has been a filthy and wanton abuse of riparian privileges which the interests of commerce have generously accorded to the petroleum

refineries and oil companies, and all workers in waste material in the Hunter's Point district. The local Boards of Health in charge of the sanitary interests of these districts are in duty bound to regulate and effectually enforce all necessary regulations concerning this matter.

Ammonia works.— The committee regret that the one great ammonia establishment visited, on the northern shore of Newtown creek, was, in some respects, in an offensive condition. Worst of all, the drainage and mechanical works were found inadequate to control the nuisance liable to be created in the manufacture of aqua ammonia, sulphate of ammonia, nitrate of ammonia, sulphuric acid, and other chemicals which are there manufactured in vast quantities.

Superphosphate Fertilizer manufactories.

The stenches that emanate from the superphosphate materials in the processes of mixing and preparation are so intolerable to all persons except the few who work at the business, that the first question is, May this kind of nuisance be properly permitted in the near vicinity of a populous district? The next question is, Can this business be so regulated and controlled that its offensiveness will be so diminished as to prevent it from becoming a nuisance? The committee deem it entirely just and dutiful to answer the first question by saying that as now and hitherto managed, under the known circumstances that embarrass the executive action of sanitary and other municipal authorities, all the superphosphate and other fertilizer works that manipulate waste animal or putrescent vegetable matters are liable, and almost sure, to be offensive nuisances; and, further, that the mixing and preparation of phosphatic materials with sludge, and even with ordinary sulphuric acid, is sure to set free certain intensely offensive gases and odors. These circumstances warrant the positive exclusion of this class of stench-producing factories from the cities and from populous neighborhoods. This should be a strictly observed regulation of every city and village. The answer to the second question is an important one for all who manage the kinds of business here referred to. The application of methods for the control and prevention of nuisances must rest with those who have their gains in them, or with the public authorities of the communities that become responsible for the presence of such business in city or village.

The committee finds that the superphosphate and fertilizer factories, and the mixing and preparation of the fertilizers in every establishment for that business which it has visited, and concerning which it has taken testimony, are nuisances that ought to be removed and wholly excluded from city and village limits.

In view of this conclusion the committee recommends to the State Board of Health that an official report to this effect should be made to the Governor.

This committee also recommends to the Board that the exposure of "sludge-acid" in any manner, or by any means that permits or causes the escape of offensive emanations from it, or from the materials with which it comes into contact, ought to be strictly prohibited and prevented within the limits of the cities, and within a mile of any populous neighborhood, unless all emanations from the sludge, and such materials, are consumed in highly heated furnaces.

The committee also recommends that wherever, within the limits of any city or village in this State, or within two miles from the limits of

any city or village, the business of storing, distilling or refining petroleum, naphtha, kerosene, or coal tar, is undertaken or permitted, it should be the duty of the local Board or Boards of Health of all such cities or villages, and it may be of the other proper authorities, to require and enforce obedience to regulations which shall secure the complete combustion of all vapors, gases, smoke and effluvia, produced by or in connection with such business, and otherwise liable to be set free in the atmosphere.

The committee would further recommend that this rule should be applied as a general law as well as a local regulation, against all offensive gases, vapors, smoke, and effluvia emanating from other manufactories, when declared to be nuisances, except so far as any of the offensive emanations complained of may be completely neutralized and rendered inodorous and innoxious by chemical and other means employed upon the premises where they are produced.

Finally, this committee recommends that the State Board of Health shall officially advise and aid the local Boards of Health concerned in the suppression of nuisances described in this report, to adopt uniform, consistent, and effectual sanitary regulations or ordinances for the suppression or prevention of these and similar nuisances; and, further, that any failure of such local Board of Health to complain of and proceed against such sources of nuisance should be reported to the State Board of Health, and to His Excellency the Governor, that the full force of any law against nuisances in districts beyond, but near to, the jurisdiction of any local Board of Health should be effectually tested, and that, if it shall be found necessary, statutes more effectual than those now existing should be enacted or called into operation.

The committee deems it a duty for the State Board of Health to call the attention of the local Boards of New York, Brooklyn and Long Island City to the pernicious results from the lodgment of offensive waste materials in and about the mouth of sewers, slips and eddying shoals along the water-sides of these cities, and that this is especially true wherever there are any waste animal or vegetable matters liable to be cast into the sewers, or slips, or docks.

The committee is of the unanimous opinion that not less than nine-tenths of all effluvium nuisances and matters of complaint by those who have given testimony on the subject, and as far as witnessed and investigated by this committee, can be wholly controlled and prevented by simple and entirely practicable means, the working of which the committee has carefully examined and proved to be now in operation. Therefore the committee recommends that whatever means and regulations have thus, or shall otherwise have been found to be good and sufficient, should be made a matter of obligation and necessity; likewise whatever cannot be sufficiently controlled by available means for the prevention of such nuisances within the cities, or their immediate populous neighborhoods, should be removed to a reasonable and proper distance from the populous districts, and wherever any of these establishments are found, they should, as a matter of course, be under suitable sanitary and police regulations established by local or general laws.

The committee has not been unmindful of the fact that the vast accumulations of refuse and waste materials in populous cities, day by day, require to be provided against by means approved by the local sanitary authorities. The prompt and carefully regulated removal of

all such materials from the cities is an important sanitary duty, and difficulties that have to be surmounted, in the proper performance of the duty, should be fully provided for under suitable regulations. Such provisions can be so ordered and located as to be harmless to the public health. This committee is cognizant of the chief improvement in the methods and execution of this duty in New York and Brooklyn.

Chemistry of the Stenches.

The committee finds it desirable to present the scientific facts which tend to explain the causes of persistence and pungency of the stenches that are chiefly complained of. Text-books of chemistry being unavailable for this purpose, the special studies of Prof. Elwyn Waller, of Columbia College School of Mines, have been made available in the elucidation of a few points in this intricate department of chemical investigation. Two points of very great practical importance are established by Prof. Waller's researches, as they have been pursued through successive years, while engaged in a practical study of disinfection.

First. It is proved that the volatilizable matters and odors that are held by the "sludge" until given off when heated, in the processes of mixing the animal and refuse matters in making the superphosphate fertilizers, are readily borne onward in the atmosphere, many miles, as offensive stenches, and that they cause much discomfort, and to the chemists, who are engaged in the manipulation of the sludge mixtures, they cause an oppressive headache and occasionally nausea and vomiting.

Second. That the stenches from the putrid animal matters, and bone boiling, bone burning, and like businesses, are readily borne great distances by the atmosphere, and are so nauseous and persistent as to be only very gradually dissipated and destroyed, except by actual combustion.

Prof. Waller's report is here appended. See page 427.

The committee has deemed it highly important to proceed promptly and with all fairness to ascertain the truth upon each of the questions referred by the Governor to the Board, and by the latter to this committee. The evidence obtained is so conclusive as to warrant the statements made in this report, and also to show that while much remains to be learned in regard to the mechanical and engineering means for overcoming the chief causes of the nuisances complained of, and much more may yet be contributed to the useful applications of chemistry, there will be no necessary hardship inflicted upon any persons by the abatement of these nuisances. The health and comfort of two millions of people and of millions of travelers require that these nuisances shall be prevented.

Respectfully submitted to the State Board of Health.

Special Committee { J. SAVAGE DELAVAN, ERASTUS BROOKS, ELISHA HARRIS.

Albany, *April* 15*th*, 1881.

At a meeting of the Board, held in New York, April 16th, the report of the special committee was read and accepted, and its several points were discussed, after which the following resolutions were unanimously adopted:

Resolved, That in the opinion of this Board the report of the special committee upon the stench nuisances complained of in the city of New York clearly establishes the fact that the complaints are well founded, that the odors emanate chiefly from the portions of Kings and Queen counties bordering upon Newtown creek, and that they are caused by carelessness in the management of the business of refining petroleum, discharging the refuse from the oil refineries, the handling of sludge acid, the making of cream of tartar, the manufacture of superphosphate fertilizers by means of sulphuric acid, the rendering of fat, the boiling and burning of bones, the manufacture of ammonia and the transportation and storage of manure.

Resolved, That in the opinion of the Board, the managers of the Empire, Standard and Astral oil refineries, and the owners of the cream of tartar factory have shown themselves to be commendably active in their efforts to control all sources of nuisance, and with the advice of competent experts have introduced improvements which accomplish that result; therefore the Board urges upon the Governor the importance of requiring the owners of other oil refineries to adopt the same or other equally effective methods of accomplishing the same results. In the opinion of this Board, no treatment or utilization of the sludge of the oil refineries should be permitted in the neighborhood of Newtown creek, nor should any portion of it be discharged into the waters of the creek. It should be removed in closed tanks entirely beyond the populous districts, without dilution or needless exposure to the air.

Resolved, That the manufacture of superphosphate, from refuse and putrid animal matter, as now conducted, is a source of emanations which should not be endured, nor should such putrid materals be stored or transported in open vessels.

Resolved, That the improper rendering of fat, and the boiling and burning of bones, and the manufacture of ammonia constitute nuisances of great magnitude, which can be easily abated by the adoption of approved apparatus already in use in many establishments.

Resolved, That the removal of manure from the large cities, and its transportation to the farms where it is finally utilized without annoyance to the residents of the localities where it is produced, or through which it passes, is a problem involving many serious difficulties, but the Board is unanimous in the opinion that it should not be allowed to accumulate in the neighborhood of crowded localities.

On motion of Mr. Brooks it was

Resolved, That the report and resolutions thereon be re-committed to the special committee, with instructions to lay before the Governor the resolutions, and such facts connected with the report as may be deemed expedient.

On the 19th day of April the committee laid before the Governor, with full explanations and evidence, the foregoing report and resolu-

tions, for his information, and the action he might deem necessary in accordance with section 8 of chapter 322, of the laws of 1880.

J. SAVAGE DELAVAN,
Chairman of the Committee.

A true copy from the transactions of the State Board of Health.

ELISHA HARRIS,
Secretary of the Board.

ALBANY, *April* 22, 1881.

The Governor immediately transmitted this report to the legislature, with the following message:

STATE OF NEW YORK:
EXECUTIVE CHAMBER,
ALBANY, *April* 22, 1881.

To the Legislature:

A special report of the State Board of Health with reference to certain nuisances existing in the vicinity of New York and Brooklyn, which seriously affect the comfort and health of the residents of those cities, is herewith respectfully transmitted for the consideration of the legislature.

It is a notorious fact that particular kinds of business, including the refining of petroleum, the utilization of animal offal, the manufacture of fertilizers and cream of tartar, aud the storage of manures, all conducted on a large scale in and near the metropolis, have been very offensive from the emanation of noxious vapors and stenches, which are denounced by the medical profession as the cause of many kinds of disease.

The recent investigations of a special committee of the State Board of Health, warrant the belief that many of the offending causes may be easily removed; at least rendered much less nauseous and hurtful than heretofore.

This subject, involving as it does the health and well-being of nearly two millions of people, is worthy of your serious attention, to the end that all necessary legislation may be secured to avert the danger now imminent.

ALONZO B. CORNELL.

On the same day (April 22), the Governor made a general order, designed to be applicable to each and all of the sources of nuisances described in the committee's report, in terms as follows:

PROCLAMATION BY THE GOVERNOR

FOR THE SUPPRESSION OF CERTAIN NUISANCES.

WHEREAS, The State Board of Health having been required by me, pursuant to law, to inquire into certain alleged nuisances dangerous to life and detrimental to public health, existing as complained, in or about New York city; and the said State Board of Health having duly reported that such nuisances, as alleged, do exist, and that they are produced by the neglect to control and properly convey away, or destroy, various offensive waste materials in the business of refining

petroleum, the manufacture of superphosphate fertilizers, fat-rendering, bone-burning and like operations done and conducted near or upon Newtown creek, in the counties of Kings and Queens, Long Island, or thereabouts, to the detriment of the health and comfort of the inhabitants affected thereby:

Now, therefore, all persons, companies or corporations owning, superintending, managing, or in any other manner engaged in refining petroleum, and in the movement and storage of the products thereof, or who transport, keep or use the substance known as sludge acid; and whoever owns or manages any premises or apparatus used for mixing, manufacturing, or storing superphosphate, or phosphate fertilizers in which sludge or sulphuric acid is employed; and whoever owns, carries on or manages any works or apparatus for fat-rendering, bone-boiling, bone-burning, or other process for utilizing waste or putrid animal matter, or otherwise engages in the manufacture of ammonia, and its salts, or other products complained of and reported by the said Board of Health to be nuisances, against health, by this Proclamation issued in accordance with chapter 322 of the Laws of 1880, take notice, that it is hereby ordered that the causes of the nuisances before mentioned and described, be by each and all of them as it may belong, prevented, removed or abated on or before the first day of June, 1881, as connected with or produced by any premises or business controlled or managed by them in singular or several.

And in case of the neglect or failure so to do by the time herein specified, official action necessary for the speedy removal and prevention thereof, will be taken in pursuance of law in such case made and provided, in the name of the people as for the removal, abatement or prevention of a nuisance against the public health.

[PRIVY SEAL.] Given under my hand and the Privy Seal of the State, at the Capitol, in the city of Albany, this twenty-second day of April, in the year of our Lord one thousand eight hundred and eighty-one.

ALONZO B. CORNELL.

BY THE GOVERNOR:
(Signed) HENRY E. ABELL,
Private Secretary.

PROCEEDINGS OF THE COMMITTEE AND OF THE BOARD CONTINUED.

The Governor having caused his proclamation to be suitably posted throughout the districts in which the nuisances were produced, the committee continued its investigations as ordered by the Board with reference to securing compliance with the Governor's orders. It was ascertained on the sixth of June that several of the petroleum refineries had adopted such structural and administrative improvements as greatly to diminish the amount of nuisance in their business; but, as more than one-half of the refiners had not yet adopted such improvements to prevent offensive effluvia, and as all, or nearly all, were still exposing a vast quantity of spent acid, or "sludge," at the water-sides, the committee found it expedient to urge that all practicable improvements and means should be brought into operation to control and prevent all kinds and causes of stench nuisances connected with the petroleum refineries. There was no doubt of the fact that these causes of pungent odors

exceed all others together, though possibly not as offensive as the superphosphate fertilizer manufactories. The petroleum business so greatly exceeded all other businesses in regard to liability to cause offense, and in regard to quantities of materials causing stenches, that unless this vast line of industry could be controlled, even to the extent of transporting daily forty-five tons or more of sludge to a distance of ten miles from the cities, it would be in vain that the State Board continued its efforts to secure the suppression of the vile effluvia which had long been justly complained of in the central district of the city of New York.

While the petroleum refiners were continuing their efforts through the summer to overcome the sources of stenches upon their premises, the ammonia manufactories ceased to produce the effluvia that had been complained of about their works, the manure dock and dumping ground, which had been a gross nuisance for many years along the northern bank of Newtown creek, were entirely cleared off and cleaned, and the business brought under new management without impairing any portion of the water-sides. All fat-boiling business east of Blissville, in Queens county, was terminated; but Blissville, which is situated in the south-eastern corner of Long Island City, upon the border of Newtown creek, continued to be a local nuisance, whether regarded as a fitting locality given up to stench-producing businesses, or with reference to each business considered separately, being occupied by fat melters, bone boilers, bone burners, swill stables, etc. None of the offensive effluvia of that place, however, was proved to be wafted to the city of New York. The place itself continued to be a great nuisance to the traveling public upon the Long Island railways, and doubtless is offensive to a certain district of Brooklyn as well as to Long Island City.

The committee's investigations were by no means confined to borders of Newtown creek. All well-attested complaints of dangerous stenches in the city of New York and in the environs of Brooklyn, especially in the vicinity of Jamaica Bay, were carefully examined into, and those evils that were found important are mentioned in the pages that here follow.

Some Results of Inspection in the city of New York.

Early in July a petition from residents of Prospect place and Murray hill was forwarded to the Governor, and by him referred to the State Board for investigation. The petitioners allege that various manufacturers and premises by them mentioned between 43d and 44th streets, were sources of stenches, and from these they prayed to be delivered.

Under a rule of the Board, an abstract of the facts was at once communicated to the local Board of Health (of the city of New York) and to the persons complained of by the petitioners. The city Board of Health at once investigated the subject, and forwarded the report of its sanitary superintendent. It was stated in this report that "most of the slaughter-houses, lard rendering establishments, and factories for utilizing animal refuse" are situated in the district on the east side bounded by 43d and 48th streets, First avenue and East river, and in the district on the west side bounded by 38th and 43d streets, 10th avenue and North river, also that the stable manure of the city is sent from that region of the water front. The same officer reports the improvements

effected during the previous eighteen months, and concludes by summarizing the results of the inspection in the following words:

"A careful study * * * * * shows that while on the very premises of these various establishments, and in their immediate vicinity, we must expect to get characteristic odors, yet during the time covered by this inspection, these smells have not extended more than one hundred yards from the premises where they were produced."

At the quarterly meeting, August 9th, Dr. Delavan, chairman of the committee, reported the inspection of two superphosphate fertilizer factories on Barren Island, where extensive ponds of sludge were found exposed in the open air, whereupon it was

Resolved.—That the committee on stench nuisances be directed to request the Governor to close at once the factories on Barren Island which disseminate odors of sludge acid, to the discomfort of the summer resort, and to furnish the Governor the names of the said factories and of the firms operating them.

Resolved.—That the special committee on stench nuisances be directed to request the Governor to close at once all refineries and other establishments at and near Newtown creek that permit sludge acid, tar, or any other refuse to run into the creek, or on the neighboring grounds, or allow offensive odors to escape from the same, until such time, as in the opinion of the committee, such improvements shall have been made in the factories, as will in future prevent such offensive discharges and odors.

Resolved.—That the committee on stench nuisances be directed to furnish the Governor the names of said factories, and of the firms operating the same.

Resolved.—That the committee is empowered to recommend to the Governor the entire suppression and closure of any factory or establishment in the vicinity of Newtown creek, from which a stench nuisance emanates to New York or Brooklyn, whether from sludge acid or other causes.

Action on causes of complaint. Coney Island, Barren Island Nuisances.

August 26th this committee prepared its report in the following terms, and upon informing the proprietors of the premises complained of, those gentlemen offered at once to remove all causes of complaint, and to keep their factories closed during the warm season:

The undersigned committee, acting under instructions of the State Board of Health, and by its authority, respectfully reports in regard to the complaints from Coney Island, as referred to this Board by you, that they find, and have proved that:—

First.—The factory and premises owned and managed by Mr. E. Frank Coe of New York, and situated on Barren Island, in the county of Kings, are producing a nuisance which is occasionally very offensive to great numbers of people on Coney Island. And this committee herewith present the proof in testimony and affidavits upon this subject.

This committee, having found the sludge-tar ponds that are now openly exposed upon the grounds and premises of said Mr. Côe to be a nuisance against the health and comfort of people upon Coney Island, request and recommend that said nuisance should be by you ordered to be abated and prevented without further delay by said owner.

Second.—This committee further find and have proved that a similar sludge-pond, now existing on the grounds and near the buildings of Messrs. Read (of 34 Beaver street, New York) on Barren Island, is also causing part of the public nuisance herein described, therefore, it is respectfully recommended that a like order be enforced against the same.

J. SAVAGE DELAVAN,
ERASTUS BROOKS,
ELISHA HARRIS,
Committee on Effluvium Nuisances; State Board of Health.

In obedience to the order of the Board the committee made its final report to the Governor August 29, in terms as follows:

To Hon. ALONZO B. CORNELL,
Governor of New York:

Governor—Agreeably to orders received from the State Board of Health, the special committee on effluvium nuisances have investigated the complaints that the Governor's proclamation ordering the prevention of certain stench nuisances has been, and is still, disregarded.

We have the honor to submit herewith the names of those persons and firms who are still causing said stench nuisances in defiance of the proclamation of April 22d, ult., with proofs and affidavits setting forth the manner and extent of their offending.

The committee have ascertained that the Governor's proclamation is generally obeyed, and that the oil refineries, particularly, are striving, by improved machinery and scientific and careful processes of working, to prevent all nuisances which have, until your order was complied with, been connected with the refining of petroleum.

The stench nuisances, as complained of to the Governor, are being effectually prevented, and with the prompt closing and removal of the two offensive establishments now reported to you as not complying with the order you promulgated on the 22d of April, this committee believe that the nuisances complained of to the Governor will have been mostly abated.

There still remain several local nuisances, near the head waters of Newtown creek, namely, one superphosphate factory, one bone-burning and five fat-rendering establisments, upon and beyond the rural borders of Long Island City and Brooklyn, eastward, but the evidence that they cause any nuisance to the people of New York and Brooklyn is not yet complete. Yet they are nuisances to the passengers upon the Long Island railroad, and for this reason ought to be abated. Though several miles remote from the city of New York, they are located on Newtown creek and "thereabouts."

This committee now return to you the various papers relating to complaints by people of Coney Island with attested proofs concerning preventable causes of stench nuisance that is suffered occasionally there.

The committee would state to you, that though some of the offensive kinds of buisness have suspended, and though even twelve great petroleum refineries are now working without causing nuisance any of them may, through neglect of supervision, again produce offensive stenches, and further, it must be noticed that there are several miles of besmeared and stench producing water-sides, decayed bulk-heads,

cribs, and structures in and about Newtown and Bushwick creeks, which cause and constitute a perpetual nuisance that will continue for years, if those water-courses are not straightened, cleansed and otherwise improved.

With great respect yours,

J. SAVAGE DELAVAN,
ERASTUS BROOKS,
ELISHA HARRIS,
Committee.

ALBANY, *August* 29, 1881.

To Hon. ALONZO B. CORNELL, *Governor of New York:*

Sir:—In obedience to directions given to the undersigned committee by the State Board of Health at the quarterly meeting on the 10th of August, inst., the following report is presented to you concerning each place and its proprietors and business that recently, and at the latest dates herein mentioned, has been found and proved to be disregarding and violating the orders and instructions made and published by you on the 22d of April, 1881:

The nuisances and the failures to comply with your orders and instructions concerning the same consist in, or are produced by, the neglect to control and properly convey away or destroy, various offensive waste materials in the business of refining certain products of petroleum, the manufacture of superphosphate fertilizers, fat rendering, bone burning, and like operations, done and conducted near Newtown creek, in the counties of Kings and Queens.

(1.) *The manufacture of superphosphate fertilizers at and near the foot of Eighth street, Long Island City, upon and within structures extending from the East river towards, and near to, West avenue, in said city.*

The business here mentioned consists in the manufacture of superphosphate fertilizers by means of mixing various animal and organic matters with sulphuric acid.

The vapors and gaseous emanations produced by, and in the processes of, the said mixing and manufacture are excessively offensive, the stench which emanates from, or with them, being very disgusting and oppressive, even at great distances from said factory and premises. Said factory and business of mixing, storage and handling are controlled by Messrs. Williams, Clark & Co.; and, further, the eastern portion of said premises is held and controlled by Mr. E. Frank Coe, of New York, and is at present used in the storage and mixing of various animal and organic materials which are used in the manufacture of fertilizers; and said materials are excessively offensive because of the stenches that emanate therefrom.

Concerning the premises, substances and business here mentioned, this committee finds, and has proved that the same are held and managed in violation and disregard of the proclamation you published on the 22d of April, and caused to be served upon the persons and owners herein named; and this committee finds that said premises and business continue to be and to cause a public nuisance.

(2.) *The exposure, keeping, movement and manipulating of "sludge acid" upon and near Newtown creek.*

This committee finds, and has proved, that certain persons, or a person named Clark, and believed to be Edward Clark, or his family and associates, openly in violation of the proclamation and instructions issued by you April last, carry on the business of conveying to and upon certain premises by them held and occupied, on and near the southern bank and side of Newtown creek, in the 17th ward of Brooklyn, and near Hunter's Point, Long Island, the substance known as "sludge acid," which is there variously exposed, spilled, steamed, and allowed to remain in such manner and to be moved and changed about by such means as violate the orders given in your proclamation and instructions in regard to the matter of sludge-acid and nuisances therefrom. This committee further finds, and is credibly assured, that since the refiners of petroleum in the State of New York have refused to sell or give to the said Clark any "sludge-acid," he has obtained and received such material from refineries in the State of New Jersey, thus demonstrating the determination to continue an offensive business which was forbidden, and is a public nuisance.

To the extent, and at the places, and by the owners and managers of premises herein mentioned, this committee finds that offenses caused by them are nuisances which violate the proclamation and instructions you issued and published on the 22d of April last. The accompanying affidavits are submitted in evidence of the correctness of this opinion. And as these are the only places and offenders that this committee has now proved to be now violating your orders within the populated district of Newtown creek, and at the same time affecting the health and comfort of the inhabitants of the city of New York, these are separately reported to you. The refineries of petroleum have at last, as the accompanying affidavits and expert reports show, fully complied with your orders, and in the opinion of this committee they can and must be required so to comply.

Other businesses and premises are causing nuisances in places beyond the districts herein mentioned, and whenever this committee is able to present to you proof of any violations of your orders and the proclamation of April 22d last, this committee will promptly report the same to you.

J. SAVAGE DELAVAN,
ERASTUS BROOKS,
ELISHA HARRIS,
Committee State Board of Health.

ALBANY, *August* 26, 1881.

The Governor's Orders.—Upon the foregoing report and the numerous affidavits accompanying it, the Governor issued an order for the abatement of the nuisance by and upon the premises of Edward Clark and Edward Clark, jr., in the 17th ward of Brooklyn near Hunter's Point, and for that upon the premises of Messrs. Williams, Clark & Co. whose fertilizer factories and storage premises were then situated at foot of 8th street East river, Long Island City. The sheriffs of Kings and Queens counties, respectively, officially served said orders, and thereupon the sludge-separating works of Messrs. E. & E. Clark on the Kings county side of the creek, suspended operations in the day time and continued their works at night; but Messrs. Williams,

Clark & Co., wound up their superphosphate manufactory and storage on the East river side in Queens county, and removed their works to a region remote from cities.

A competent inspection was maintained until September 3d, when the causes of the nuisance were found to be abated and controlled, without the necessity of calling upon the Governor for his action.

Further Report on Newtown Creek Nuisances.

SPECIAL REPORT COMMITTEE EFFLUVIUM NUISANCES.

Presented at the Quarterly Meeting, Nov. 9, 1881.

The special committee appointed by the State Board of Health to investigate this effluvium nuisances in and around Hunter's Point, Newtown creek, and the water fronts of New York, Brooklyn and Long Island City, being notified of the action of his Excellency the Governor, directing the abatement of certain offensive trades and industries, made a final inspection of the location on Saturday, November 5, inst.

Accompanied by Mr. Howard Potter, president of the New York Sanitary Reform Society, and Albert L. Colby, Ph. B. inspector State Board of Health, we visited each of the twelve great oil refineries, and found that the guarantee given by Mr. Henry H. Rogers for the twelve refineries on August 29 ult., in which he, in the name of said several refineries, promises to "conduct the business of refining oil in such a manner as not to produce noisome or offensive smoke or smells; to prevent the open exposure of spent or sludge acid at any place within fifteen miles of any city in the State of New York, during the warm season, or within eight miles of any such city during the cold season; also that such impure acid shall not be allowed to flow, leak or waste into or upon the ground or streams; also, that cokes, tarry or oily wastes used as fuel shall be so perfectly consumed that no hurtful or offensive smoke or stenches shall be produced, and finally that the business of the refiners shall be so conducted as to prevent any just cause of complaint on account of any noxious or offensive smells produced by them in any manner;" this has been in process of fulfillment with the following results.

1. As regards offensive smoke and vapor from firing. Where a few months since numerous lofty chimneys were pouring forth black smoky vapor laden with offensive gases, destined to be wafted for miles to the annoyance and discomfort of the people of the environs, we found the process of firing going on without smoke. Great care had been taken in the management of stoking, and minute and careful supervision had been exercised over those whose duty it is to keep the fires fed with fuel. It seemed to the committee that the smoke nuisance had been almost, if not wholly, abated.

2. As to the nuisance heretofore existing from the escape of deleterious and noisome gases into the air during the opening and clearing out of the stills:

By a system of metal hoods and air-tight conduits, devised by Prof. H. B. Nason of the Rensselaer Polytechnic Institute, chemical expert adviser to the refineries, each still as it is opened, discharges its gases into these closed tubes instead of into the air as formerly; these are conducted by means of strong suction to the furnaces, where they are

totally consumed without any possibility of their escape into the surrounding atmosphere. It is found that the gases and vapors produced, by the opening and clearing out of one still, will supply fuel enough to heat one furnace for the space of twenty minutes — thus actually proving of pecuniary advantage to the manufacturers themselves. We regard this system, if properly attended to, as it appears to be, a total prevention of nuisance from the escape of vapors and gases injurious to health during the process above mentioned.

3. Spent or sludge acid. We found no evidence that spent or sludge acid was used or manipulated by the oil refiners. The amount produced by the twelve refineries, some forty-five tons per diem, is pumped into closed metal-lined tanks or boats without exposure to the air, and conveyed as often as need be to the distance agreed upon in the guarantee given by Mr. Rogers.

4. As to the leakage of sludge acid into the ground or into the streams:

A system of drainage has been devised carrying all water impregnated with oily or tarry material through a succession of traps, one lower than the other, partitioned by a number of diaphragms. The oily portion remains on top, being drawn off by a simple system of siphonage, and the water, purified of its harmful constituents, is then allowed to pass into the stream.

It will be seen by the above description of what has been accomplished that, by concentrated and united action on the part of the oil refiners, they are conscientiously endeavoring to comply with the Governor's orders, and the great improvements made in the system of refining petroleum without offense to the people proves emphatically what was stated to the Board by the committee at a former meeting, namely: that nine-tenths of the effluvium nuisances could be prevented by the proper application of what science has shown to be possible and practicable. The abatement of a nuisance of this kind means "the expenditure of a considerable amount of money," and certainly, when public health demands, it should be done at any cost. The oil refiners have made an excellent beginning, and the committee are of the opinion that they will continue to exercise the proper precautions, so that nuisances from this branch of industry will practically cease to exist.

Do nuisances still exist, notwithstanding the improvements made by the refiners, and in spite of the care exercised by them? Does sludge acid still continue to be manipulated and discharged into the creek at Hunter's Point?

There still remains the establishment of Edward Clark, who is engaged in the process of separating sulphuric acid from the impure material, sludge. Not being able to procure the spent acid from the refiners, he brings it from New Jersey, and is daily violating the Governor's orders in the manipulation of the vile material, and the discharging of it into the stream itself. We have ample proof of this, but also are assured that by the Governor's latest orders this will soon cease. Application has been made to the Governor praying for time to work up stock on hand from the fertilizer factory of Williams, Clark & Co., 8th street, East river, but it will not be granted, and this establishment, as well as that of Coe and others, will be obliged to close. Other industries producing various stenches, such as the bone boiling and burning, and fat

rendering establishments, are now working so that no official complaints concerning them have been transmitted by the Governor to the State Board.

Nuisances on Barren Island.

Complaints made to the Governor from the hotel proprietors on Coney Island concerning the stenches wafted by certain winds from Barren Island, from the several stench-producing trades carried on at that place, were referred to this committee for investigation. It is believed that these nuisances are abated, although it has not been accomplished without much careful watching, and by peremptory orders from the Executive.

As far as this committee has had the power to investigate, advise and report, it has done so, and we feel that our work in the matter is accomplished — that each and every nuisance complained of has been minutely examined and carefully studied. Full reports of inspectors, and of experts engaged in the work of investigation, are on file, with all documents, complaints and papers relating thereto. What has already been accomplished in abating these nuisances has its history, which is ready for the inspection and action of the Board.

We believe that the people of our State owe a debt of gratitude to the Governor for his prompt and impartial action in sustaining the State Board of Health in its crusade against the preventable causes of disease and death amongst the people.

J. SAVAGE DELAVAN,
ERASTUS BROOKS,
ELISHA HARRIS,
Committee on Effluvium Nuisances.

At the meeting of the Board held November 9th, 1881, it was—

Resolved, That the special committee on effluvium nuisances be requested to prepare a complete report of its labors to be incorporated in the annual report.

Resolved, That the committee continue its work as a committee of observation, with power to employ inspectors for such localities as have been, or are engaged in, causing stench nuisances.

Sanitary Inspection in the Stench Districts.

As ordered by the Board a daily inspection was maintained in the stench districts under direction of this special committee. The exact and trustworthy information thus obtained has enabled the Board to ascertain and put on record the nature and extent of the various stench-producing premises and works in the Newtown creek region. The details relating to this inspection which was continued up to December 1st, and one branch of which is still maintained, need not here be reported; but the committee appends an abstract of certain expert inquiries and records made by Inspector Albert L. Colby, Ph. B., a competent chemist, who has made three tours thrice weekly through the petroleum refining and stench districts.

Concluding Summary.

This committee respectfully submits to the Board the foregoing summary of the records and results of procedures which the Board instituted and ordered in February, 1881. It is a record of work carefully organized and maintained with all reasonable recognition of the rights and necessities of every legitimate industry, and with full information concerning the facts and difficulties which must be confronted in the manipulation, storage and utilization of the waste and refuse of cities which now contain nearly two millions of people, and of the still greater difficulties that attend the manipulation and refining of nearly four hundred millions (400,000,000) of gallons of petroleum annually, all in near proximity to the very center of the metropolitan population. And this committee had, from the start, a fixed purpose to secure the intelligent convictions and consent of enlightened owners and managers of the chief of these various industries to recognize and find ways to accept the conclusions which this committee and the State Board of Health should, in the progress of the investigation, announce as necessary or dutiful for the public health.

The petroleum industries, their vastness, the commercial exigencies and the world-wide demand for the refined products of petroleum; the capitalized millions which enable a single centralized syndicate to resist or to comply with requirements for sanitary regulations of everything pertaining to the business that has hitherto produced stenches, compelled this committee to consider most deliberately the importance of every step of its procedures. Having found that the syndicate interests must be induced to lead in, and if need be, coerced, into compliance with all the practicable improvements — structural and administrative — that are now shown to be necessary in order to prevent stench niusances from petroleum and its products, this committee conferred repeatedly with representative managers of the petroleum refineries, and on August 29, a guaranty was drawn and duly signed in terms as follows:

(*Copy of Guaranty of Petroleum Refiners.*)

New York, *August* 29, 1881.

To the Members of the State Board of Health, Albany, N. Y.:

Gentlemen: — In compliance with your request that a guarantee be given of the effort and ability of the refiners at, and near, Hunter's Point, to conduct their business of refining oil in such a manner as not to produce noisome or offensive smoke or smells, or in any manner to work injury or offense to the neighborhood and community at large, I, as a party interested, representing and on behalf of the said several refiners, and in consideration of the pledges heretofore made to your Board by, and on behalf of such refiners, do hereby promise and agree that hereafter the said refiners, and each of them, will prevent the open exposure of spent acid, the product of such refineries, at any place within fifteen miles of any city in the State of New York, during the warm season, or within eight miles of any such city during the cold season; that neither spent acid, nor any other offensive material used by, or the product of such refineries, shall be permitted to flow, leak or waste into or upon the ground or streams, so as to cause offensive or hurtful odors to enter the atmosphere; and that whatever cokes, tarry

or oily wastes, or other odorous substances, shall be used at or by said refineries as fuel, shall be so perfectly consumed that thereby no hurtful or offensive smoke or stenches shall be produced, and that all the business of said refineries shall be so conducted as to prevent any just cause of complaint on account of any noxious or offensive smells produced by them in any manner.

Very respectfully,
(Signed) HENRY H. ROGERS.

The terms of this guaranty have been accepted and acted upon by twelve companies represented by the guarantors in good faith, and with as much success as could reasonably be anticipated. Success, however, in the constant observance and enforcement of the almost endless series of details in minutiæ of duty, from the humblest stoker at the furnaces to the superintendent of the apparatus and the products of the stills, of the agitators and the storage tanks, is found to demand such intelligence as well as rigor of supervision upon every part of the refining premises as only a few of the separate establishments have yet secured. The larger of these establishments, however, have already succeeded in reaching what seems to be for the present a minimum of offensive effluvia, and all of the twelve (now fourteen) separate refining establishments, in the vicinity of Newtown creek, now succeed in wholly controlling and keeping under seal from the atmosphere all the "sludge" products, and in conveying away the same in sealed tanks, as guaranteed in the paper above quoted.

There remain all vapors and emanations from petroleum in its natural and marketable forms, and from the light-oil products of distillation, its stored distillates, its tarry residuum at the refining establishments, and from the products of combustion of the coke, tarry and other material used as fuel, and there remain also the uncovered and sodden grounds and the insufficiently protected bulkheads of a great part of the entire areas and water-fronts of the refineries. Recent improvements, as witnessed at the Standard, the Empire, at Sohn & Flemmings and the Astral companies' works, illustrate the nature and utility of the improvements that have been made in these matters.

The entire removal of all the sludge produced in the region of Hunter's Point seems to be a success beyond further criticism; yet at the same time in the midst of the refineries on the Kings county side, a manipulator of sludge for the recovery of sulphuric acid from it has continued this offensive business regardless of all the orders he has received. The total suppression of that nuisance, however, is certain to follow soon.

Safe disposal of the sludge acid.—The effluvia from the sludge acid whenever and wherever that material is exposed to water or vapor, or is applied to any animal or putrescent matter, is so indescribably odious and so far-reaching and persistent in the atmosphere and in any place reached by its foul emanations, that the nearest distance, even in the cold season, for its open exposure in any manner has been deliberately fixed by the guarantors themselves, at a distance of not less than eight miles from any city; while in the warm season the distance is fixed at a minimum of fifteen miles. Though a marketable product for the solution of bony and earthy phosphates, containing as it does one-half of its own volume of

pure sulphuric acid, the voluntary sacrifice, of the entire quantity, namely of from forty-five to fifty tons daily, marks the correct view and the public spirit of the guarantors, who know how intolerable the nuisances of sludge emanations are in the midst of or near to the city and town populations. Some of the results of attempts to use the sludge on Barren Island at the beginning of the summer, and the well-known nuisance of one sludge manipulator on Newtown creek, have sufficiently proved that it is necessary to remove this residuary product of the refineries as far as practicable from the population, which the deep tides, flowing as they do five, six and more feet, utterly fail to cleanse away.

The committee has given its attention to the conditions which demand the practical solution of an engineering problem now necessarily thrust upon the attention of the commercial metropolis of the world, because the most extensive and intolerable nuisances that have ever been smelled have been there produced, and must be abated and prevented. Nearly the entire area covered by the refineries and by the other businesses upon the water sides here described, are upon filled-in ground or made land. Three or four of the best conducted establishments have so covered, drained and cleansed the entire surface of their grounds, and so filled out upon the tide front and bulk-headed with solid facings, that the causes of nuisances we have just described are already being reduced to a minimum.

This kind of improvement must be enforced as a condition for the continuance of such businesses. Further than this, the commercial interests which now move many million barrels of petroleum, and other materials upon and through other much used waterways in front of the most populous and opulent region of the city of New York, cannot justifiably be longer neglected. The estuaries of Newtown creek and of the East river, require sanitary protection and treatment, and such skillful engineering of this problem is a condition precedent for the great improvement upon which the sanitation of an area now covering some five square miles of neglected estuary and creek surface, with the occupied and offensive grounds, depends. Newtown creek itself must in the judgment of this committee, and of the best judges that it has been able to consult, be drained, straightened, filled out and bulk-headed, in such manner as to forever protect it from relapsing into the condition it now so conspicuously occupies, in the nostrils as well as the eyes of the world, as a public nuisance.

It is not for this committee to discuss the public economy of the measures here suggested for it is a sanitary necessity; and such is the commercial value of all this region of mud and sodden filth, that, in the judgment of the committee, were a just and reasonable law, to prescribe the conditions of occupation and usage of those water fronts and low-lands, simply with reference to sanitary obligations of such ownership and usage, commerce itself would be sure to gain manyfold for the entire expenditure it would make, without the aid of public funds, for the removal and prevention of nuisance in that entire district.

This committee will not refrain from expressing the hope that at an early period the National government will carry into full effect its delayed purpose to dredge, straighten and protect the channel of Newtown creek, for commercial enterprise has already indicated the readiness and avidity with which it will meet the requirement of sanitary improve-

ment, that must soon be made obligatory as a condition of occupation, and use of the old marsh lands, and borders of Newtown and Bushwick creeks

There will be remaining obstinate nuisances, that inhere in the very filth and foulness of the region itself, until the improvements here indicated are made throughout ground surface, and water fronts, as well as in the creek-channel.

Alkaline washings.—In their efforts to control the outflowing of the alkaline washings, which flow from the agitator that produces the offensive sludge acid, all nuisance would be prevented were it not for the fact that a considerable quantity of tarry matters, and pungent odors are held in the caustic washings, and until recent improvements demonstrated that these offensive matters could be controlled, they carried into the tidal fronts of Newtown creek and the East river, a source of nuisance that was everywhere visible. This, as shown in preceding statements, is no longer necessarily a source of complaint. Unfortunately several of the companies do fail properly to trap and control this last washing and outflow from the kerosene.

The foul borders and bed of Newtown creek.—The continued outpouring of vile residuary matters from the petroleum refineries, from knackeries, bone-boilers, distilleries and fat-melters, from rendering-tanks, from manure and garbage dumps, and from various chemical factories along the banks of Newtown creek the past many years, have left its borders, and its bed deeply covered with dense and very offensive material, more loathsome and unsubdued by storms and time, than the bitumen and slime of the Dead sea itself. The locality reeks with indescribable filth.

Further Conclusions.

(1) Whatever commercial interests may prompt and perform in the sanitary and general improvement in the regions about Hunter's Point, sanitary law and regulations should have full sway there, and to this end every manufacturer and business may need to be kept under systematic sanitary or engineering inspection adapted to prevent the various evils that are bred of neglect and inattention, or from the unsuitableness and insufficiency of preparation for the business that is being conducted offensively.

(2) That the trades and kinds of business that are in themselves necessarily, or from any cause, habitually offensive to such a distance as to be complained of in any of the populous streets of New York, Brooklyn, or Astoria (the dwelling center of Long Island City), should be excluded from the districts as herein described.

(3) The committee has obtained ample evidence that a very large proportion of all the trades and business connected with the utilization of waste materials of cities, as centralized in the region of Newtown creek, as well as the management and refining of petroleum, can be so conducted as to cause no public offense, and that this result requires adequate intelligence, rigorous enforcement of all necessary rules and practices in the works and upon the premises, and, without exception, a sufficient investment and use of capital.

(4) That the experience and good judgment of the chief capitalists and scientific men who have undertaken any share of the works hitherto

accused of producing stench nuisances, as made known to this committee, fully warrant the conclusion that they can and must be induced to lead in and insure the reforms which the public health requires and the popular will demands. The guaranty given by the syndicate of oil refiners near Hunter's Point is striking evidence on this subject, and the following words from the scientific director and chief member of one of the largest firms engaged in the utilization of waste animal products for fertilizers, a firm that has been required to close its works and remove far from cities, confirms the statement made in this committee's preliminary report in April last concerning the necessity for defining the lines beyond which all nuisance-producing businesses of kinds that are not, or cannot be controlled, shall by law, statutory and sanitary, be required to remove: "We concur entirely with the conclusions of your committee. Likewise whatever cannot be sufficiently controlled by available means for the prevention of such nuisances within cities, or their immediate populous neighborhoods, should be removed to a reasonable and safe distance from the populous districts." This representative of the superphosphate manufacturing interests further stated that in "so agreeing we are now taking steps for removal to some less populous situation."

This committee would now conclude what it has to say upon this subject by quoting the statement it made in its report to the Governor in April last, and by adding to the above statement, which has been accepted in a good degree as here shown, "wherever any of these establishments are found, they should, as a matter of course, be under suitable sanitary and police regulations, established by local or general laws."

Respectfully submitted,

J. SAVAGE DELAVAN, *Chairman.*
ERASTUS BROOKS,
ELISHA HARRIS,
Committee on Effluvium Nuisances.

[A]

Preliminary Memorandum on the Investigation of Stench Nuisances submitted February 23rd, 1881.

The nuisances to be investigated are those which produce emanations that so pollute the atmosphere as to become the cause of urgent complaints and denunciation in the city of New York, and which presumably are sources of offense in certain portions of the other cities in the vicinity of Newtown creek.

The location of these nuisances complained of in that locality is such that the offenses are alleged to be "noisome and offensive smells, generated either at Hunter's Point and other places on Long Island, by agencies unknown to your petitioners, and which are brought into this city by winds and other natural causes, or else arising from the carrying on of offensive trades in the said city."

The following sources of effluvium nuisances have been recently complained of and described by the Brooklyn Board of Health, namely: Gas works and their imperfect methods of purification, the Wallabout Oil Works, the Astral Oil Works, the Oleophene Works, the Kings County Oil

Works, Washington Company's Oil Works, Franklin Oil Works, Green Point Oil Works, Donald's Oil Works, the Standard Company's Oil Works, three to five fat rendering works, the Bristol Curing Works.*

The nuisances complained of by the New York Board of Health and by the Long Island City Board of Health, consist of the Fertilizing Company's works, on the right bank of Newtown creek; the ammonia works on the right hand,—not far east of 34th street ferry;—numerous rendering and fat melting works; various places, especially in the vicinity of Blissville; the manure docks and dumping grounds, on the Long Island City side, for manures brought from the city of New York; the petroleum refineries along the water-sides at and beyond Hunter's Point; the various factories; sulphuric and muriatic acid works, and various refineries and chemical works within the limits of Long Island City, and on both sides of the creek. Upon the New York side: the manure-docks and dump-yards on the East river side; the butcheries and fat-melting houses between 43d and 48th streets; several oleomargarine factories; the works of Messrs. Rafferty & Williams for melting and refining fats, in the same region; all the gut and tripe works in New York city; the varnish factories and filthy outflowing from about the old market establishments in the Second and Third wards of that city. Besides these there are effluvium nuisances resulting from mismanagement and defective apparatus of various chemical works, and common industries which produce vapors and smoke, or which defile the sewers with heated poisons, vapors and gases that are not yet sufficiently described in the sanitary reports of the three cities concerned in this matter. In the course of the pending investigation, some of these will doubtless be found to play an important part in the total of effluvium nuisances now complained of. Steam-exits into unventilated sewers have an important relation to the wide distribution of apparently *unaccountable odors* which enter the houses and vex the inhabitants in districts remote from sources of evils suffered.

The compound gases of which hydrogen is a constituent and a ready carrier, especially if in the form of ammonia, whether alone or in other complex gases, aid the wide and rapid diffusion of the stenches, and become the most common vehicle of various poisonous and offensive effluvia.

The naphthous and other light oleaginous vapors from petroleum, have their own natural laws of distribution, and are certainly readily conveyed from the atmosphere by the winds to a very great distance retaining most pertinaciously their special offensive qualities for longer and for greater distances than the ammoniacal gases and effluvia.

Compounds of carburetted gases, nitrogen, cyanogen, sulphur gases, chlorine, etc., are evolved at various places in connection with certain trades and waste materials, and are poisonous, irritating and a cause of indignant complaining by the inhabitants who suffer from them.

Sulphuric acid, which is a most convenient oxidizer and chemical agent for the purification of petroleum, and for the solving also of all bony and earthy phosphates and various other materials that have larger commercial uses, becomes an offensive carrier of vast volumes of hydrocarburetted and sulphuretted vapors that render it a cause of nuisance that is of the utmost importance, because of the quantity, extensive dis-

* Report of Health Department of the city of Brooklyn, 1875-1876; pages 123 to 128.

tribution, and disgusting offensiveness of the emanations from it. The "sludge acid," as such loaded sulphuric acid is termed, has been until recently the most intensified and indescribable of nuisances. Even at the present time, with all the improvements that are known to be practicable, and which are practiced by some of those who are responsible for it as a cause of nuisance, vast quantities are poured out upon, or beneath the tidal waters of Newtown creek at the beginning of each flood tide daily, to float as far as it may inland before the turn of tide, and then, with the returning tide, to be borne back into the East river, besmearing both banks of the Newtown estuary between Brooklyn and Long Island City.

The accusation of any one place as the source and cause of this offensive practice is in vain, until each offender is in succession detected; and so many refineries and factories have their share respectively in this aggregate of nuisances, that its suppression will require exact statements of evidence, and a comprehensive application of sanitary law. There are several other sources of effluvium nuisances of a complex nature and hidden and carefully sequestered sources, which require fearless and very faithful investigation.

The running of distillery waste and of blood and other waste of albuminous animal matter into the sewers and bulk-heads, *culs des sacs* of New York water sides, adds a vast quantity of material to the putrescent matters in the sewers and along the water-front. In summer time this is a serious source of evil, greatly augmenting the quantity of offensive emanation from sewers and bulk-head-slips.

In the plan of the investigation of effluvium nuisances, the following outline is to be followed as far as convenient:

The complaints, petitions and complainants will be examined.

The nature, location, name, extent, degree or intensity of the offensiveness which is complained of, will need to be verified.

The testimony will be divisible into knowledge and proof of what is seen and known to exist, and, secondly, into evils recognized by the effluvia complained of, but whose source and responsible producers are not positively known, yet each must be ascertained by the committee.

List of some of the Known Causes of Stench.

1. Manures.
2. Fats and oils (animal and vegetable).
3. Ammonia and alkali works, and gas works with their ammonia liquor.
4. Treatment of metals and metal waste, particularly in the recovery of tin, etc., from the waste material with which it is found in such processes.
5. Fat melting, and all methods of "*rendering*" fatty and fleshy substances.
6. Roasting, boiling, and burning of bone and other animal matters.
7. Accumulation and mismanagement of city garbage.
8. Neglect and mismanagement of putrid fish and other putrid organic matter.
9. Defective methods, and lack of protection of the atmosphere in various chemical processes, in which cyanogen, ammonia, sulphuretted, sulphide, and carburetted gases are evolved.

10. The manufacture and storage of super phosphoretted and ammoniated fertilizers.

11. The refining of petroleum, entire management, methods, utilization, and final disposal of the spent or "*sludge*" acid.

12. The manufacture of sulphuric and other acids.

13. Varnish and enamel factories.

14. Gelatine and glue factories.

15. The manufacture of salts of lead, tin and other metallic preparations.

16. Tanneries of special kinds.

State-Regulation and official Investigation of Effluvium Nuisances in other Countries.

IN FRANCE.—The Napoleonic Sanitary Code classified all sources of effluvium nuisances in the same manner as we have done upon the preceding pages, and for upward of fifty years the good results of exact regulation of causes of nuisances have been well recognized in Paris and other great cities of France. No less than one hundred and thirteen trades, occupations and kinds of storage are ranked under the French sanitary system, and in what we have here given as the first class, namely, that which requires regulation and inspection, but may be permitted within city limits and built-up towns, while of the second class, namely, that which requires strict regulation and some limitations as to the place in which they may be allowed to exist, there are 90 industrial occupations enumerated, and in what we have made our third class there are no less than 89, and these are sources of defilement of the atmosphere which cannot justifiably be permitted within or quite near to built-up cities and villages.

IN ENGLAND.—Inquiries extending through the period of forty years past have established the fact that certain numbers or kinds of sources of effluvium nuisance must be wholly excluded from cities and populous neighborhoods, and the same inquiries have also established the fact that by far the greater number of offensive businesses may, and should be rendered inoffensive, and that when capital shrewdly applies itself to preventing nuisances attendant upon particular trades, the profits that result from the prevention of the decay, disintegration, wastage and slovenly methods, the profits of the business so reformed as to being inoffensive, are enhanced, and that *capital so invested* quite surely turns to profit.

In a search continuing through four years and ending a few months ago, the Local Government Board of Great Britain covered a very extensive series of investigations relating to some 70 kinds of offensive businesses which have for the past fifty years been continually accused as nuisances in that country. No less than 850 separate trade establishments were inspected and fully reported upon by Dr. Ballard, the chief of the National Sanitary Inspection of Effluvium Nuisances. Most of these were common trades, ranging all the way from soap-making, hair-cleaning, etc., to gas works.

In this inspection in England, by Dr. Edwin Ballard and his assistants, the following points were aimed at from the first:

"1. The extent and degree of the inconvenience to the community occasioned by industrial nuisances.

"2. The industrial processes, or the parts of industrial processes which produce effluvia complained of as offensive.

"3. The evidence that these offensive effluvia are also injurious to health.

"4. The methods which are in use, or may be devised, for preventing or minimizing nuisance from them.

"5. (Incidentally). The difficulties experienced by local authorities in dealing with this class of nuisances."

The tracing of offensive gases and emanations to their actual sources, though difficult, was well accomplished in the English investigation, and has been proved to be possible in regard to effluvium nuisances in the vicinity of the city of New York. The combination of several kinds of offensive gases and vapors which occurs in the Hunter's Point district and in the populous cities, naturally brings several sources of atmospheric defilement under one general accusation until those separate sources are separately traced. This is not always entirely practicable, because different businesses may nevertheless produce nuisances which closely resemble each other. Ammonia works and guano stores, for example, may have offensive odors that are chemically identical. The evidence of what each place and business contributes to the common nuisance often is to be obtained only by close inspection of the processes of the business itself.

Effluvia that are Injurious to Health.

It may justly be conceded from the start, in such inquiries, that persons who have become habituated to offensive odors may be found to be hardened and be rendered insensible to them, and, further, those who have suffered seriously from them have generally retired away from the business in which they were so exposed. Dr. Ballard, in his recent great study of the subject in England, soon reached the conclusions—

First.—That "it must be obvious that trade effluvia constitutes one item in the long list of circumstances which cause the air of a town to differ from country air."

Second.—That the unhealthful influence from effluvia may be simply from the effect of filth and its gaseous product; it may also be saturated with, and convey, infectious matter causing disease.

Third.—A stench may consist of chemical elements, or compounds, which, in addition to being offensive, are irritating,—sometimes poisonous— and generally injurious to life in proportion as they concentrate in any region or place. The acrid, irritating effect produced upon the surface of the body, respiratory and other mucous membranes. are among the definite evils complained of. The stenches may, independently of this effect, produce serious disturbance of health, and may act as poisons to the blood of those exposed to them.

Dr. Ballard reached the final conclusion, that notwithstanding that anyone of the effluvium nuisances may be highly injurious to health, it is found where the numerous sources of effluvia are combined, it is not possible to determine the extent or nature of the *share* which any one business has in the production of the total result from all. He also proves that by the application of "such knowledge as is now at hand, all, or nearly all, businesses which are now in a serious degree offensive, may be carried on either without offense, or with such important reduction of offense, as shall make it tolerable, or even trivial."

ACRID AND IRRITATING STENCHES.

The gases and effluvia which escape from sulphuric acid that is employed as a chemical purifier, or force, whether in liquid or in powder and semi-fluid materials yields some of the most irritating vapors and gases; and it will be found that this is now, or recently has been true in a marked degree in the vicinity of Hunter's Point. "Sludge acid" whenever it is exposed, and however it is used in the open air, is an example of this evil. Many of the businesses in which naphtha, the naphthous compounds, and the production and handling of the nitro-benzole compounds are carried on, are,—like the ammonia works and the exposure of "sludge acid" to the atmosphere,—traceable, with much certainty, to their sources. The destructive treatment of animal matters also yields effluvia that can be traced, in most instances, to their respective sources. The class-room experiment of placing upon separate plates the flesh or tissues of different animals, finely cut up, and then pouring on a small quantity of sulphuric acid, to answer the question, What animal is this odor from? is witnessed upon an enormous scale at the super-phosphate fertilizer works.

Will any Expert Inspection and Testing be Required?

The testimony which has already been well taken by the Municipal Boards of Health in the three cities that will be concerned in this investigation, now shows, that certain highly important questions relating to the identification and location of some of the persistent sources of effluvium nuisances have not yet been determined beyond all dispute or doubt. The testimony concerning some of these nuisances appears not yet to be satisfactorily exact and complete.

After the testimony of the petitioners and other complainants, together with that of a certain number of expert witnesses. has been obtained, it probably will be found that the State Board of Health must command for itself a certain kind of expert inspection, and certain expert testimony. What this service may need to be will appear after a considerable amount of testimony has been taken by this committee. The more comprehensive and exact this investigation by the committee is made, the more complete will be its public usefulness, and the more satisfactory it should, and must be, to all persons legitimately concerned in the offensive businesses that are to be under examination.

It will be found as true in New York as it has been in England and Scotland, as stated by the English government sanitary Commissioner Ballard, that "it is commonly found in practice to be as much to the interest of the manufacturers as of the public that the emanations from offensive processes should be thus arrested."

Facts concerning the success already attained in the mitigation and prevention of effluvium nuisances in the city and vicinity of New York in recent years.

When the Metropolitan Board of Health came into existence, in the spring of 1866, there were one hundred and seventy-three offensive slaughter-houses in the built-up parts of the city. Swine herds, swine-pens, fat-rendering establishments, and in all, more than a thousand

very offensive sources of effluvia, detrimental to health, were found in the city, at the beginning of the summer of 1866. Even the neglect of manure dumps was then an insufferable source of nuisance. The several gas manufactories then purified their illuminating gas very imperfectly, so that sulphuretted hydrogen, sulphide of ammonium, and various poisonous compounds with the carburetted effluvia from those places polluted the atmosphere of the city.

The city garbage, and the dumps for street dirt were also insufferable nuisances. Some idea of the nature and extent of these nuisances, will be obtained by referring to pp. *xciii* to *xcvi* of Citizens Sanitary Survey of the city of New York, in 1865. Lime kilns, shell-burning, bone-black establishments, and numerous other grossly neglected industries, were offensively conducted. The ammonia liquor from the gas-houses, and any other purgent volatile materials were poured into the establishments wherever convenience dictated, while the sewers themselves from the many butcheries in the city became permanent sources of offensive effluvia, which have since been removed from nearly all the built-up districts of the city. The nuisances of the gas manufactories have been mostly overcome and prevented, and this has been accomplished by sanitary chemistry and engineering. The gas-houses still remain where they are, and they have more than doubled the amount of illuminating gas produced daily. The whole change for the better has been effected by chemistry and improved administration. The slaughtering of animals used for food has been so far removed from the central districts of the city, that whatever nuisances they now produce, are upon an infinitely reduced scale, as regards their extent and degree. The ammonia works have been removed from the city altogether, excepting in one of the water-side neighborhoods, where the proprietors claim to overcome all effluvia by their perfected apparatus, and improved factory administration. Whether this is so or not, may yet have to be proved.

Blood, offal, dead animals, fats of all kinds, have been brought under sanitary regulations, and they have diminished their offensiveness a thousand fold. The storage of offensive materials is now reasonably controlled, wherever there is such storage within the city of New York. Bone-boiling and the rendering of animal matters for fats continue to be offensive, but vastly less so than before the sanitary reform commenced fifteen years ago.

Nuisances that have new and aggravated sources of stench in the past ten years.

(1.) The refining of petroleum, and the mismanagement of waste and volatile materials in that business.

(2.) The increase of works for producing super-phosphates for fertilizers and other purposes.

(3.) A vast increase in the quantity of coal consumed, thus liberating carburetted and sulphuretted gases in immense quantities.

(4.) The general increase of manufactories that produce large quantities of wash and volatile matters, that add to the total amount of offensive effluvia in and near the city.

The greatest of all the causes of pungent and injurious effluvia that have thus been increasing year after year, and now are at their height,

are presumed to come from the refineries and chemical manufactories. The first class of these is represented by the exhalations incident to the exposure of sludge acid, and the volatile substances evolved in the refinement of petroleum. The second would comprise all offensive businesses that evolve ammoniacal, sulphuretted and carburetted phosphoretted gases and volatile vapors.

Sources of putrescence.

With the increase and the growing density of the population in and about the city of New York, a corresponding augmentation of waste and decaying organic matters (animal and vegetable) occurs. The gaseous and volatile effluvia from these materials are sources of great danger as well as offensiveness. To know, control and prevent these sources of nuisances has been one of the chief and most serious tasks of the sanitary authorities of New York and Brooklyn. To prevent the occurrence of accumulations and effluvia of waste and organic matters requires more rigorous sanitary law and regulations, and a larger amount of police interference than have hitherto been regarded as entirely practicable.

Suggestions to citizens who are aggrieved by the stench-nuisances that are said to originate from offensive businesses or other causes in the vicinity of Hunter's Point, Newtown creek, and the water-sides of New York, Brooklyn and Long Island city.—In any instance of specially distinguishable offensive odors which pollute the atmosphere at a particular time in a place, or over a district, that can at the time be described, let a record of the facts be made then and there, let the nature of the odors be described in plain terms, and at the earliest opportunity thereafter, and a copy of the facts may be given to this committee of the State Board of Health. If any opportunity occurs, and the facts should warrant it, there will be such an investigation made as should discover and verify the sources whence emanate the effluvia complained of.

In 1868–9 the Metropolitan Board of Health secured the suppression of great rendering, fat melting and bone boiling establishments, already had brought nearly two hundred slaughter-houses and their offensive accessories under regulation, and required that business to be carried on in regions north of the built up districts mostly above 40th street. The gas manufactories were all required to adopt the iron process of purification in addition to their other methods, and the gas liquor was regulated by restrictions that rendered it far less offensive than formerly.

In 1869 the manure-dump nuisances were diminished and so regulated (within the city) as to lessen and nearly terminate the complaints on account of them. In 1870 and 1871 they again were found in their old places defying the three Municipal Boards of Health that had superseded the Metropolitan Board.

The gas-house nuisances continued suppressed, with the exception of the exposure of the gas liquor or ammonia water.

The establishment of the ammonia works on Newtown creek created such a demand for this ammoniacal liquor, that it was no longer poured into the sewers of New York and Brooklyn. There had been for several years small ammonia factories near the gas-houses on the east and west sides of the city, now there is but one, namely, near the

foot of west 18th street. Great as have been the complaints concerning ammonia nuisances on the Newtown creek borders, they were vastly less than those requiring attention in the city of New York before this recent demand for the gas liquor was created.

Fat-boiling and the rendering of offal that at one time was driven away from the city, excepting on the very limited portion of the water-side:—

In 1873–74–75 the sanitary demands upon the sources of stench nuisances were urged with new success and resulted in a removal of nearly all of them beyond the limits of the city of New York, the fat-melting and manure dumps being the chief exceptions. The intensity and persistency of the effluvia that floated upon the atmosphere from the region of Hunter's point, west and north-west, and, in particular, conditions of the atmosphere, south-west also, causes complaining against them to be very widespread from the region of Canal street, for example, on the south, to 75th street on the north, and from East to the North river. Within those limits there dwell about 600,000 inhabitants. The entire area of Long Island City is invaded by the same vapors, and the extensive region of Brooklyn, E. D., during certain prevailing winds.

During the four years and upwards that the Metropolitan Board of Health was pressing its improvements, the nuisances in the Hunter's Point region were greatly reduced, as can be testified by Dr. Trask, the sanitary inspector of the Astoria and Hunter's Point district and by Dr. Bailey, inspector of the Newtown district. The withdrawal of the inspectorial surveillance after the relegation of the Metropolitan authority to the municipal government was followed by a rapid increase of the stench-nuisances, for neither the authorities at Hunters's Point or Long Island City, or those of Brooklyn successfully maintained the stringent regulations the Metropolitan Board had adopted. E. H.

B.

The Chemical Nature of Effluvia produced by certain Manufacturing Operations.

To the Special Committee of the State Board of Health:

The gases and vapors produced in manufacturing operations may be roughly classed as those exclusively of a mineral character, as chlorine from bleacheries, etc., and those of an organic character. Of course, according to the nature of the operations conducted, the two may be more or less commingled. It is with the latter class that we have here to deal. These organic (or more properly carbon) compounds, evolved from manufacturing operations may be divided into—

1. Those of an acid character which may be absorbed or fixed by bases, such as potash, soda, lime, etc. Sulphuretted hydrogen, sulpho-carbonic acid,* phosphoretted hydrogen, acetic acid and the like may be mentioned as examples.

2. Those of a basic character which may be absorbed and fixed by acids. These usually contain nitrogen (ammonia may be taken as the

*Sulpho-carbonic acid is the result of the unions of carbon disulphide with sulphuretted hydrogen, a compound being formed which affords a series of compounds with bases similar to carbonates with sulphur in the place of oxygen, Eg. $K2\ CO3$ potassium carbonate, $K2\ CS3$ potassium sulpho-carbonate. Carbon disulphide when pure has a rather pleasant ethereal odor, but as ordinarily delivered for manufacturing operations, contains other sulphur compounds of carbon, etc., of acid character (at least, which may be absorbed by bases, as potash and soda), which give the odor so well known to those who have to deal with it in any way.

type), and as examples of bases of this character, nicotine and conine may be mentioned. Some contain phosphorus forming the class known as phosphorines or phosphorus bases.

3. Those of a neutral character not fixed by acids or alkaline bases. Such may be hydro-carbons, as members of the paraffine, olefine or other series, oxygenated hydro-carbons, as compounds of the nature of alcohol and ether or sulphuretted *hydro-carbons* of corresponding constitution, etc.*

4. Besides these, with some kinds of material, organized germs or spores may be present in the gases, resulting from the decomposition of organic material, which exert a dangerous influence upon human health. These usually, though not necessarily, always are accompanied by gases or vapors belonging in the previous classes.

The emanations here chiefly to be considered are those arising from the manufacture of refined petroleum, of fertilizers and of the various products from bones. A brief statement of what, so far as known, the crude products contain, and the mode of manufacture, is here necessary.

Crude petroleum.— This consists chiefly of the series of hydro-carbons known as the paraffine series ($C_n H_{2n+2}$) of which marsh gas (CH_4) is the type. The first members are gaseous at ordinary temperatures, and as the number of carbon atoms (and the hydrogen atoms correspondingly) increase in the molecule, give readily condensable gases, then liquids having boiling points higher and higher, until we reach forms solid at ordinary temperatures and known commercially as "paraffine."

In smaller proportion petroleum also contains some of the olefines, $C_n H_{2n}$, and probably at least three other compounds, viz.: one or more containing sulphur, one or more coloring matters, and one or more odoriferous compounds. The following table from Watt's Dictionary, IV, 385 (also III, 181) with the addition of the leading number of the series (found by Fouque) indicates what is known in this regard:

NAME.	Formula.	Boiling point. Fahrenheit.	Specific gravity.
Methyl hydride	$C\ H_4$	Gas.	.....
Ethyl hydride	$C_2\ H_6$	Gas.	.....
Propyl, or Trityl hydride	$C_3\ H_8$	Gas.	.....
Butyl, or Tetryl hydride	$C_4\ H_{10}$	32° to 39°	0.600
Amyl, or Pentyl hydride	$C_5\ H_{12}$	86°	0.628
Hexyl hydride	$C_6\ H_{14}$	143°	0.669
Heptyl hydride	$C_7\ H_{16}$	197½° to 201°	0.699
Octyl hydride	$C_8\ H_{18}$	241° to 244½°	0.726
Nonyl hydride	$C_9\ H_{20}$	278° to 280½°	0.741
Decatyl hydride	$C_{10}\ H_{22}$	320° to 323½°	0.757
Udecatyl hydride	$C_{11}\ H_{24}$	356° to 363°	0.765
Dodecatyl hydride	$C_{12}\ H_{26}$	385° to 392°	0.776
Tridecatyl hydride	$C_{13}\ H_{28}$	421° to 424½°	0.792
Tetradecatyl hydride	$C_{14}\ H_{30}$	457° to 464°	.....
Pentadecatyl hydride	$C_{15}\ H_{32}$	491° to 500°	.....

* Paraffine series, $C_n H_{2n+2}$, type=Marsh Gas CH_4. Olefine, series $C_n H_{2n}$, type=Olefiant Gas $C_2 H_2$, etc. Alcohol $C_2 H_6 O$, ether $(C_2 H_5)_2 O$. Mercaptan $C_2 H_6 S$. Hydrosulphuric ether $(C_2 H_5)_2 S$.

The following olefines have also been detected by Warren:

NAME:	Formula.	Boiling point. Fahrenheit.
Decylene..................................	$C_{10}H_{20}$	347°
Undecylene....................	$C_{11}H_{22}$	384½°
Dodecylene.................................	$C_{12}H_{24}$	421°

The boiling points and specific gravities given are those observed by Pelouze and Cahours. The results of other observers vary slightly from these.*

Of course petroleum from different sources contains different proportions of these compounds. In some cases some may be entirely absent. Of those compounds existing in small amounts in petroleum we have at best very indefinite information, though no doubt some of them are partly responsible for the odors which render the neighborhood of petroleum refineries so objectionable.

The process of refining petroleum is conducted as follows: The oil is distilled in large retorts, the successive portions as they come over being kept separate. The products become heavier and heavier as the distillation progresses, and the process is controlled by tests made with a Beaumé hydrometer. The first distillate has a gravity of about 95° B. When the gravity attains 65° to 59° B., the stream of the distillate is turned into the burning oil tank, into which it is allowed to run until the gravity is about 38° B., when the stream is again diverted into the paraffine oil tank, the distillation being continued until an oily *coke* remains in the still.

The last portions have a gravity of about 25° B.

The products are usually in about the following proportions:

Naphtha, 15 to 20 per cent of the crude oil.

Burning oil, 55 to 65 per cent of the crude oil.

Paraffine oil, 20 per cent of the crude oil.

Coke, gas and loss, 5 to 15 per cent of the crude oil.

By slow distillation, the paraffine oils may be "cracked" into the lighter burning oils, and the yield of burning oil is increased with the destruction of the paraffine oils. The process results in the formation of olefines; for example

$$\dagger C_8H_{18} \text{ may be decomposed to } C_4H_{10}+CH_2$$
$$\text{or } C_3H_8+C_2H_4$$
$$\text{or } C_2H_6+C_3H_6$$
$$\text{or } CH_4+C_4H_8$$

Some refiners distil by passing steam through the oil to remove the more volatile portions instead of applying the heat to the outside of the still, or a combination of the two modes of heating may be used.

The oils resulting from the distillation are "sweetened," as it is termed, by agitation in lead-lined tanks with one or two per cent of the strongest oil of vitriol of commerce (sulphuric acid) of 66° Beaumé,

*P. *Schweitzer:* Lecture on Petroleum; Columbia, Mo., 1879. *Fouque:* Comptes Rendus, LXVII, 1045. *Ronalds'* Jour. Lond. Chem. Soc., XVIII, 54, 529. *Pelouze and Cahours:* Comptes Rendus, LIV, 124; LVI, 505; LVII, 62; Ann. Ch. Phys. [4] I, 5; Ann. Ch. Pharm., CXXIV, 289; CXXVII, 196; CXXIX 87. *Schorlemmer:* Chem. News, XI, 255. *Warren:* Am. Jour. Sci. [2] XL, 89, 216, 384 and XLV. 262. *Warren and Storer:* Mem. Am. Acad. Sci. New. Ser. XI, 208.

†Watt's Dictionary, 2d Supp., p. 892.

Thorpe and *Young:* Jour. Lond. Chem. Soc. [2] IX 342, X. 802.

containing 93 to 95 per cent of acid. The acid carbonizes some of the impurities (in the same way in which it acts upon sugar), and also by forming chemical combounds or by mechanical adherence, carries out the impurities (odoriferous and other) which contaminate the product. The acid on settling to the bottom is drawn off and known as sludge. The oils are again agitated with alkali to remove the last traces of acid, and are thus ready for the market.

The refuse products are, the cokings, naphtha and the sludge.

The cokings or "still-bottoms," as they are sometimes termed, often possess a strong and unpleasant odor, but as the operation of distilling has removed the most volatile portions of the oil, the odor does not extend very far. These cokings are usually burned under the stills or boilers. The naphtha contains many of the light hydro-carbons, together with a considerable proportion of the compound referred to as giving the distinctive odor to the petroleum. The sludge contains carbonized tarry matters, and a compound of volatile nature and penetrating odor, the composition of which is at present unknown. It seems possible that it may be some compound or modification of the substance referred to as to giving the characteristic odor to the petroleum.

The investigation of this substance is attended with great difficulty, on account of its volatile and penetrating qualities. With most persons the fumes produce dizziness, severe headache, and even vomiting. In my own case the headache resembled that produced by exposure to nitroglycerine so far as I recollect. In one case that came to my knowledge, nausea, sufficient to prevent the retention of any thing on the stomach for some little time, was also produced.

In distillations conducted on sludge oil by Mr. A. L. Colby, a student of the School of Mines, the major part of this compound (determined by the odor of the distillate) came off at temperatures below 320° F. In my own experiments small amounts were obtained at temperatures below 212°, it probably, therefore, volatilizes at temperatures in the neighborhood of 212°. The odor is *indescribable*, but has something of a garlic quality about it, which would imply the possible presence of a sulphuretted compound. A rough test on the unpurified distillate indicated the presence of a small amount of sulphur, but whether as an impurity or as a constituent, it is impossible to say. The compound is evidently of the neutral class of substances, since it is not absorbed or neutralized by either acids or alkalies.

Strong oxidizing agents, as chlorine, etc., appear to have some effect in altering its constitution and converting it or some of its constituents (for it may be a mixture and not a definite compound) into compounds having a rather pleasant aromatic odor. I am inclined to suspect that it may be allyl C_5 H_{11}, or some compound of that series or its derivatives (sulphur or oxygen compounds), but further investigation is necessary to decide more definitely upon its constitution and character. Such an investigation would be of great value, both from the point of view of the sanitarian and of the manufacturer. In this connection I desire to quote from Dr. Ballard's report on effluvium nuisances, Sixth Annual Report of Local Government Board, 1876–1877, England, p. 125. "The use of due means to prevent effluvium nuisances in industrial establishments of all kinds often turns out to be in a variety of ways, direct or indirect, and often unforeseen, conducive to prosperity. This is a fact which those

most largely engaged in many of the most offensive businesses now recognize more or less completely."

The Tunyoap resin manufacture, U. S. patent 178,061, the recovery of pure sulphuric acid from sludge, and the superphosphate manufacture, would all be benefited by a knowledge of the nature and constitution of this substance.

2d and 3d. Fertilizer, manufacture and bone working.—As these deal with substances of animal origin, they necessarily go together, since for them, the major part of the raw material consists of substances from that source.

Animal matters may be roughly classed under (*a*), bones; (*b*), fat; (*c*), flesh, blood, nervous tissue, etc.

Bones.—About one-third of the weight of bones are organic substance (Berzelius), *i. e.*, combinations of carbon, hydrogen, nitrogen, etc.

The principal constituents of this animal matter are nitrogenous compounds, as gelatine, etc., fats or oxygenated hydro-carbons Some phosphoretted and sulphuretted compounds also probably exist in them.

Crude fats contain the fatty acids combined with glycerine, and the membrane inclosing the fat, during the life of the animal, which contain nitrogenous compounds.

Flesh, blood, etc., contain substances built of atoms of carbon, hydrogen, nitrogen and sulphur, and in some cases phosphorus.

The products of the decomposition of bones by the slow and natural process of decomposition have not, so far as I am aware, been studied. They are no doubt similar in many respects to those obtained in the operations of manufacturing bone black and ammonia salts from bones. The composition of bone tar (Dippel's oil) was made the subject of an elaborate investigation by Prof. Anderson in 1848 to 1854,* and by his labors several compounds were isolated and identified.

These were:

Acids.—Carbonic, CO_2; hydrò-cyanic or prussic, HCN; hydro-sulphuric (sulphuretted hydrogen), H_2S; an acid oil consisting of a mixture not separated.

*Trans. Roy. Soc., Edinb., XVI, pt. 4, Apr. 1848, XX, pt. 2, Apr. 1851, XXI, pt. 1. Apr. 1854.

	Formula.	Boiling point. Fahrenheit.	Specific gravity.	Properties and remarks.
Bases:				
Methylamine	$CH_5 N$.	Gas	....	Strong ammoniacal odor; pungent
Ethylamine	$C_2 H_7 N$.	75½°	0.696	Ammoniacal and putrid odor.
Prophylamine	$C_3 H_9 N$.	150°	....	Strong pungent odor.
Butylamine	$C_4 H_{11} N$	175°	....	Very volatile; pungent odor.
Amylamine	$C_5 H_{13} N$.	201°	0.750	
Pyrridine	$C_5 H_5 N$.	240°	0.986	Odor more pungent than picoline.
Aniline	$C_6 H_7 N$.	360°	1.020	Oily; vinous odor.
Picoline	$C_6 H_7 N$.	275°	0.961	"Odorine" of Unverdorben; overpowering odor.
Lutidine	$C_7 H_9 N$.	326°	0.946	Pungent aromatic odor.
Collidine	$C_8 H_{11} N$.	354°	....	Aromatic odor.
Pyrol bases	....	212° to 370°	....	Odor disgusting; major part distilled 280°–310°.
Neutral substances:				
Benzol	$C_6 H_6$.	176½°	0.85	Odor pleasant
Homologues of benzol Pyrol	$C_4 H_5 N$.	133°	1.077	
Alcohol radicals — Nitrogenous compounds of fatty acids	....	....	....	Decomposed by sodium.

All the bases emitted their peculiar odor at ordinary temperatures, although many of them have high boiling points.

Although, according to Dr. Anderson, but three-quarters of one per cent of the Dippel oil consisted of bases, yet these bases, on account of their volatility, give the chief character to the oil so far as odor is concerned. Possibly none of these bases, may be produced when bones are otherwise treated or are allowed to decompose, but undoubtedly, compounds similar in character and in general properties, will form.

Composition of Fats, and products of their decomposition.

As already stated, fats consist of fatty acids combined with glycerine. The following are some of the most important fatty acids :

NAME.	Formula.	Boiling point.	Odor.
Butyric	$C_4\ H_8\ O_2$	....	Rancid.
Valeric	$C_5\ H_{10}\ O_2$	347°	Strong ; unpleasant.
Caproic..........	$C_6\ H_{12}\ O_2$	392°	Sudorific.
Caprylic	$C_8\ H_{16}\ O_2$	448° to 451°	Feeble ; unpleasant.
Capric...........	$C_{10}\ H_{20}\ O_2$	....	
Palmitic	$C_{16}\ H_{32}\ O_2$	....	
Oleic............	$C_{18}\ H_{34}\ O_2$	....	
Stearic	$C_{18}\ H_{36}\ O$	....	

Glycerine has the formula $C_3\ H_8\ O_3$.

The fatty acids are freed from their combinations with glycerine by heat and pressure combined (the process pursued by soap boilers), or by the fermentation induced by the action of the inclosing membrane. This fermentation also will cause decomposition of the palmitic, oleic and stearic acids into the more volatile fatty acids. The nitrogen in the inclosing membrane by this fermentation also affords ammonia; and the application of heat at this stage gives rise to the formation of amides which are, mostly, neutral nitrogenous substances.

The odorous products of the decomposition of crude fat may be tabulated as below, though the list is no doubt far from being complete.

Acid substances.—Carbonic, acrylic, butyric and other volatile fatty acids.

Bases.—Ammonia.

Neutral substances.—Caprylene $C_8\ H_{16}$, and other olefines. Acrolein $C_3\ H_4\ O$, boiling at 126 1-2°. The latter compound is produced in the destructive distillation of fats or glycerine, and has an intensely irritating odor.

Flesh, blood, nervous tissue, etc., contain many highly complex compounds, some containing only nitrogen beside carbon, hydrogen and oxygen, others containing sulphur or phosphorus in addition. Very few of these compounds have received any definite formulæ.

Of those containing nitrogen — gelatin may be taken as an example; and containing sulphur also are the proteids — such as albumen, casein.

etc., and containing phosphorus, is nerve-matter, etc. The proteids contain: Carbon — 52.7 to 54.5 per cent. Hydrogen — 6.9 to 7.3 per cent. Nitrogen — 15.4 to 16.5 per cent. Oxygen — 20.9 to 23.5 per cent. Sulphur — 0.8 to 1.6 per cent.

When fresh, these compounds are usually free from unpleasant odor, but being of a highly complex character, they readily decompose by natural or artificial processes into other compounds, many of which are of an extremely nauseous or otherwise objectionable character.

The nitrogen may afford ammonia or bases of the general characteristics of those described under the decomposition products of bones.

The sulphur may give acids of the character of sulphuretted hydrogen or sulpho-carbonic acid, possibly some sulphur bases, and sulphur alcohols and ethers, mercaptans, etc.

The phosphorus may give phosphoretted hydrogen or phosphorus bases (phosphines).

Manufacture of Fertilizers.

The raw material may be generally described as chiefly refuse matter of all kinds which may contain nitrogen or phosphoric acid. More specifically we may mention: Dried and refuse blood and blood-clot from the manufacture of blood albumen; "Tankage" (called in England "greaves"), the refuse material from which the fat has been extracted by boiling and pressing by the fat-boilers; bone-refuse from bone-boilers, glue-makers, bone-workers, retail butcher shops, etc., bone-black dust from bone-burners, or exhausted black from sugar refineries; tendons, hoof and horn clippings, etc., after the glue and size have been extracted ("Scutch"); hide scrapings and trimmings from tanneries; leather scraps; hair fit for no other purpose; slaughter-house refuse, bones, fat and meat; fish refuse from the drying and curing of fish, extracting the oil, etc.; sugar scums from sugar refineries, rocks from mineral deposits containing phosphate of lime (South Carolina phosphate rock, etc.); sulphuric acid or sludge acid in its place. For some special purposes, crude sulphate of ammonia, or chloride or sulphate of potassium may be employed.

Mode of manufacture.—The object of the manufacturer is to produce a material which shall contain certain percentages of soluble superphosphate of lime, and of nitrogenous substance which, by decomposition, will afford ammoniacal compounds. The usual proportions in the fertilizers made are, ten per cent soluble phosphoric acid, with about one to three per cent phosphoric acid not converted to soluble form, and two to three per cent of ammonia with 10 to 20 per cent of moisture. The materials (except the sulphuric acid) are mixed together according to what is on hand, and the quality of the product desired, and after thorough mixing the sulphuric acid is poured over the mass and stirred in, either by hand or by machinery.

The sulphuric acid is usually of the kind known as "chamber acid," *i. e.*, such as is taken from the sulphuric acid chambers in which it is made, without concentration, having a gravity of about 50° Beaumé, and containing 60 per cent or over of pure acid Where sludge acid is used, the sludge from the petroleum refineries is too strong, and is therefore diluted with about one-fourth its bulk of water, the tar or sludge oil is allowed to separate, and the acid, thus diluted, is used.

The proportion of acid to the other material is usually about one-half by weight. Thus a charge for hand-mixing will consist of about 200 lbs. of material to 100 or 120 lbs. of acid.

After mixing, the charge is turned out and spread to dry for a few days, when it is ready for shipment. Sulphuric acid of the above degrees of concentration, as is well known, evolves much heat on mixing with water, so that the dilution of the sludge when that is used, or the addition of the acid in either the pure or impure form to the material (which always contains more or less moisture), produces a considerable rise in temperature, which will volatilize the compounds already present or formed by the action of the sulphuric acid upon the constituents of the charge, which can assume the gaseous form at such temperatures.* The basic constituents of the charge, by their union with the sulphuric acid, also aid in the rise in temperature.

With fresh materials and fresh acid, the escaping vapors have a strong odor of sulphurous acid and a somewhat unpleasant organic odor, which, however, diffuses rapidly, and does not extend far from the mixing tub. With material which has been kept until decomposition has begun, the vapors may contain, besides the above, sulphuretted hydrogen, volatile fatty acids, and some products similar or identical with those acid or neutral compounds mentioned, as resulting from the decomposition of bones, fat and animal matters. Such odoriferous compounds, especially the fatty acids, and some of the organic sulphur compounds may be perceived at some distance, perhaps half a mile or more, depending on the state of the atmosphere.

When sludge acid is used the odor is more intensely disagreeable, since to these organic products is also super-added that of the compound or compounds referred to as existing in the sludge. This odor will extend to great distances, *at least five miles, if atmospheric conditions favor; and possibly farther.* The sludge compound seems to carry with it some of the organic compounds alluded to, and even at a considerable distance the odor of the nauseous organic compounds, as well as the sludge odor, may be detected.

Bone-boiling.—The raw material has already been described. The material is often allowed to lie in heaps until more or less putrefaction has taken place before it can be treated.

The mode of treatment is by covering the bones with water, and applying heat either by firing below, or by passing in steam. In a few hours the fat has been extracted and the boiling is interrupted to allow it to rise to the surface, when it is skimmed off. The boiling is then resumed and continued uninterruptedly for some days in order to extract the gelatine. The liquor is then run off and evaporated down to a proper consistency, when it is allowed to cool to a jelly, which is cut up and dried on net-work stretched on frames.

The bones are allowed to dry, after which those of suitable size and quality are usually picked out and sent to the bone-workers, the others, together with the chippings from the bone-working, being used to manufacture bone-black.

At each step in the process, including the drying of the bones, if

*Dr E Ballard (6th Report of Local Gov't Board, London, 1876–77, p. 255) states that the temperature of a charge three or four minutes after mixing the charge was found to be 240° F. A heap three or four days after leaving the mixer had a temperature of over 210°, and another heap, which had been cooled by a fan for 16 hours, showed 180°

proper care be not exercised, the ill-smelling compounds referred to under the head of Decomposition — products of bones and of crude fats may be evolved, such as nitrogenous bases and volatile fatty acids, together with organic sulphuretted compounds in some cases.

Bone-burning.— The burning is effected in large pots set in a furnace (which is said to yield the best product) or in retorts resembling those used for gas when it is desired to save the bone-tar and ammonia-salts resulting from the distillation. After the burning is completed the black is broken up, screened and sent to the sugar refineries, etc.

When the burning is effected in pots, the major part, or all of the volatile products of decomposition, are burned in the furnace. When, however the burning in pots is mis-managed, or the products of decomposition are attempted to be saved, and are not properly condensed, the substances mentioned by Anderson as existing in the bone-tar may escape into the atmosphere, giving a pungent and persistent odor, which may be perceived at considerable distances.

Chemical nature of effluvia produced by certain manufacturing operations.

To sum up, then, the nuisance caused by petroleum refining, may result from —

I. Distilling off the lighter portions of the petroleum or their subsequent treatment, affording:—naphtha vapors, light hydro-carbons; the substance referred to as giving the distinctive odor to petroleum.

II. Treatment of the distillates with steam or with sulphuric acid, affording: — the volatile compound or compounds referred to as existing in sludge as well as the above.

III. Cleaning the stills by steam, affording the same as I (above).

The nuisances caused by fertilizer manufacture are —

1. Heaps of decomposing material, affording: — sulphuretted compounds, volatile fatty acids, nitrogen bases, etc.
2. Diluting sludge, affording: — the volatile compound or compounds referred to as existing in sludge.
3. Mixing sludge acid with the organic material; and:
4. Cooling, drying and storing the fertilizers, affording: — the above, together with acid and neutral compounds mentioned as resulting from the decomposition of animal matters.*

The nuisances caused by bone-boiling are —

1. Heaps of decomposing material, affording: — essentially the same products alluded to under fertilizer manufacture under the same circumstances.
2. Boiling for fat, affording: — volatile fatty acids and the products of the decomposition of fats mentioned, as well as nitrogen bases.
3. Boiling for glue, affording: — essentially the same as the above, the nitrogen bases predominating.
4. Drying the bones, affording:—pungent nitrogen bases.

The nuisance caused by bone-burning affords compounds mentioned in the table of substances obtained from bone-tar.

Of all the compounds described or indicated, that from sludge, the nitrogen bases and the volatile fatty acids, appear to travel the furthest without diffusion, and therefore, to be perceptible at the greatest distances

* To this may be added hydrofluoric acid when (as is sometimes the case) a phosphate rock containing fluoride is used. This compound is usually more of a source of annoyance to the workmen than to the neighborhood.

in about the order named. A subject worthy of attention in this connection is the question as to the power of certain volatile compounds to carry certain others with them to considerable distances. Ammonia and carbonic acid are believed to have this property. It is confidently asserted by some concerned in the manufacture of illuminating gas, that naphthaline (a heavy hydro-carbon, solid at ordinary temperatures) will be retained by the gas unless the ammonia is removed, and that as soon as the ammonia is taken out it condenses. Several facts observed seem to substantiate this view. If it be true, the principle no doubt holds good for compounds other than napthaline, and possibly for others than ammonia, and has an imporant bearing on the subject of effluvium nuisances. In conclusion, we remark that the compounds causing the stenches most complained of from manufacturing operations, of this class, have extremely complex chemical characteristics. Many of them are remarkable for retaining their offensive qualities, even when borne considerable distances through the air.

Respectfully submitted,

ELWYN WALLER, Ph. D.

SCHOOL OF MINES, COLUMBIA COLLEGE,
NEW YORK, *April*, 1881.

[C.]

Abstract of Inspector Colby's notes on Offensive Trades in the vicinity of Newtown Creek and Hunter's Point.

To Dr. J. SAVAGE DELAVAN,
Chairman of Committee on Effluvium Nuisances:

In answer to instructions received from your committee, I have the honor to submit the following report on the offensive trades at Hunter's Point, Newtown creek and vicinity. The district comprised in this report has been for years the subject of much complaint by the citizens of New York city, and partial but temporary relief has been secured by the efforts of their local Board of Health.

The exact parts of Queens and Kings counties comprised in this report are Long Island city, as far north as 13th street (which includes Hunter's Point), both sides of Newtown creek as far up as Penny Bridge (which includes Blissville), the shore lines of Greenpoint, of Bushwick Inlet, of Williamsburg, as far south as north 9th street. The importance and extent of this evil may be clearly seen by reference to the accompanying map, which shows that this extensive district lies directly opposite that part of New York city bounded by Grand street on the south and 42nd street on the north. Hence, offensive effluvia arising from separate industries along this extensive shore line, and combining in the upper strata of the atmosphere, are easily wafted by east, southeast or north-east breezes, directly over a wide and central band of the city of New York, including our best city residences, as well as our most popular tenement house districts.

This region has been occasionally and irregularly visited from October 4th to December 21st.

During these inspections information has been sought on the following points:

1. The causes in the various trades that give rise to the offensive effluvia complained of.
2. The chemical nature of these effluvia.
3. The methods taken, if any, by the manufacturers to prevent or lessen their production of nuisances.
4. The degree of compliance with the Governor's proclamation by those engaged in the offensive trades mentioned therein.

This division of offensive trades mentioned in the Governor's proclamation, will be used in this report to classify the information obtained on the above questions.

Petroleum Refining.

This industry, the most extensive in the district, deserves a somewhat detailed consideration.

The objectionable features will be referred to, noting the steps in the process of refining in their order.

Fractional distillation of Petroleum.—This operation is conducted in large cylindrical retorts or "stills," connected with a coil of wrought iron pipe, submerged in a tank of water for the purpose of cooling. The first products of distillation are gases; at ordinary temperature they pass through the coils and escape without being condensed. The vapors soon begin to condense and the first distillate obtained has a gravity of about 95° Beaumé. As the distillation proceeds the products become heavier and when the gravity reaches 65° to 59° Beaumé, the stream of *distillate* is turned into the "burning oil" tank into which it is allowed to run until the gravity is about 38° Beaumé, when the stream is diverted into the "paraffine oil" tank, the distillation being continued until only tar remains.

Products of the Fractional Distillation of Crude Petroleum.

NAMES.	Limits of Gravity Beaumé.	Average Gravity Beaumé.	Specific Gravity	Boiling Point.	Average yield of Pa. oil of 45° Beaumé.
1. Gases, uncondensed.	....	......	....	....	....
2. Cymogene...........	115 to 105 deg	110 deg	.600	32 deg F	....
3. Rhigolene...........	105 " 95 "	100 "	.625	65 "	....
4. Gasolene............	95 " 80 "	87 "	.664	120 "	1.5 per ct.
5. Naphtha (refined)....	80 " 65 "	73 "	.700	175 "	10.0 "
6. Benzine........ ...	65 " 60 "	63 "	.750	250 "	4.0 "
7. Kerosene, burning oil.	60 " 38 "	46 "	.807	340 "	55.0 "
8. Lubricating oil (com'n)	38 " 25 "	30 "	.885	885 "	17.5 "
9. Paraffine............	....	......	....	....	2.0 "
10. Coke...............	....	......	....	....	10.0*"

*This figure includes the uncondensed gases at ordinary temperature (Nos. 1, 2 and 3), the tar, and loss.

In actual practice one refinery does not make the entire list of *distillates*, but disposes of crude distillate to others for purification.

Odor of uncondensed vapors.—The escape of the light hydrocarbons produced during the first part of the distillation is *now* prevented by a simple system of hoods and suction conduits, which lead the gases

from each still down into its own fire, thereby burning them without offense.

Odor of crude distillate.—This is produced by exposure, in tanks with the covers open, in order to receive the benefit of sun-light and wind in bleaching and purifying the oil. The source of evil is entirely unnecessary.

Odor in cleaning Stills.—This operation was a source of nuisance; after the last distillate has run off into the "heavy oil-tank," there yet remains in the still tar and some soft coke. The tar is first drawn off into closed tanks, and subsequently mixed with coal-dust for fuel. The still is then cleansed of remaining vapors by blowing in steam, as it is termed. This steam, with offensive vapors, was until recently allowed to escape into the air. But, by the same effectual method used in consuming the uncondensed gases, these offensive gases are now completely consumed, thereby removing a large factor in the combined nuisance of an oil refinery, as well as materially saving in the consumption of fuel.

Production of Smoke.— Improvement has been made in the abatement of this source of nuisance. In most of the refineries, the fires are started with wood and broken coal, and no "mixed fuel" (consisting of pea coal, dust and other refuse tar, and coke from the stills) is used until the fire is perfectly lighted. There are some refineries, however, in which this important matter is grossly neglected, and defective "stoking" renders, in all the refineries, the frequent or occasional production of an immense volume of smoke, which could be prevented by more careful superintendence of the stokers.

Treatment of the Distillate — Agitation with Sulphuric Acid.

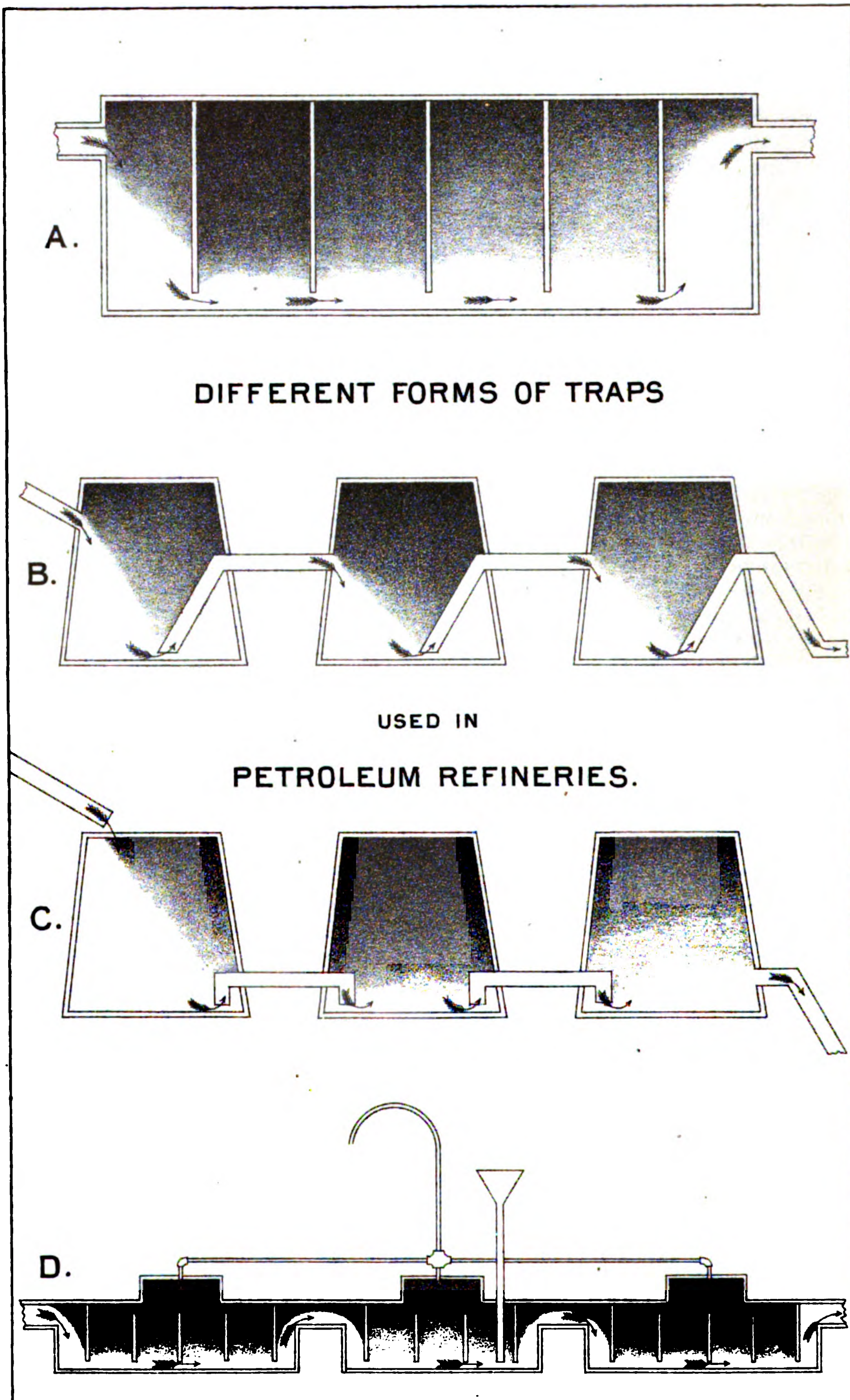
The crude distillate (as well as naphtha and lubricating oil) resulting from the fractional distillation as described, is next purified or "sweetened" by thorough agitation in cylindrical lead-lined tanks or upright "agitators" with from 1 to 2 per cent, by measure, of the sulphuric acid of 66° Beaumé. The agitation is effected by blowing air through the liquid by means of a pipe extending nearly to the bottom of the tank. By this means the acid removes the offensive properties of the distillate, partially by carbonization as well as by chemical combination; and also, by virtue of its gravity. The impurities thus removed are —

1. The offensive characteristic odor of the crude distillate.
2. The tarry and gummy matters which would render the oil useless by the rapid incrustation of the lamp wicks.
3. The color, disagreeable to the eye.

After this thorough agitation, on standing, there separates a dark red, tarry liquid which is drawn off from the cone-shaped *base* of the agitators. This constitutes the well known "sludge" or "spent acid," as it is termed by the refiners. The oil is then washed with water; then with an alkali (usually caustic soda) thus neutralizing all remaining acid, and leaving the oil "sweet" and colorless, ready for the market.*

Exposure of Sludge-Acid.— The effect of improper manipulation of this offensive product has been a great nuisance. In this important matter eleven of the thirteen refiners have united in adopting a system

*Some refiners wash the oil again with water after treatment with alkali, and occasionally redistillation or exposure under glass to the sun is resorted to.


A.
DIFFERENT FORMS OF TRAPS
B.
USED IN
PETROLEUM REFINERIES.
C.
D.

of improvement by which from the time the sludge-acid is made in the agitator until it reaches Barren Island (during the winter) and the ocean (during summer) it is not in any way exposed to the atmosphere. The importance of this improvement warrants the explanation of the mode of accomplishing the result. The "sludge" is drawn from the agitator, as soon as it has settled out of the oil, into a small *pressure-tank;* from there it is forced into the covered *storage-tank,* at or near the dock of each refinery. Two sealed tank-boats under control of Chas. Pratt & Co., one of the 11 guarantors, are used in conveying the "sludge" from the refineries away from the cities. To prevent escape of gases, in filling the boats from the storage tanks, a large pipe runs from the top of the tanks on the boats down four feet in the water so that the gases forced out by the filling of the tanks are absorbed.

Waste of Oil in Wash-water.—The refiners have found it to their advantage to hold, by a system of traps, all wash-waters from the agitators and even the soakage-water of their premises. Several forms of traps are used in the refineries for this purpose, all having for their object the retention of the water in order that the oil may thoroughly separate from it and be syphoned off for retreatment. The accompanying drawings show in section the different styles of traps used.

In conclusion, it is seen that the centralized action on the part of the refineries to comply with the Governor's proclamation, has resulted in the suppression of a nuisance in almost every step of the process of refining.

Manufacture of Superphosphate Fertilizers and the Storage of Materials.

In the stench-district there are three fertilizer factories and three storehouses.

In the manufacture of the fertilizers made at these factories, the following raw materials were found on the premises:

1. Phosphatic rock (from South Carolina and elsewhere).
2. Kainit (chloride of potash).
3. Nitre (nitrate of potash).
4. English phosphatic fertilizer (prepared).
5. Guano (Peruvian and other).
6. Cotton-seed meal (after oil has been pressed out).
7. "Tankage" (the refuse material from which the fat has been rendered by boiling and pressing).
8. Bone-refuse (from the bone-boilers, glue makers, bone workers, retail butcher-shops, etc).
9. Bone-black dust (from bone-burners or exhausted "black" from sugar refineries).
10. Sugar-scum (from sugar refineries).
11. Dried and refuse blood and blood-clot (from the manufacture of blood albumen).
12. "Scutch" (the tendons and hoof and horn clippings, etc., after glue and size have been extracted).
13. Hide scrapings and trimmings (from tanneries).
14. Leather scraps.
15. Hair, fit for no other purpose.
16. Fish-scrap, dried fish and fish bones (from the drying and curing of fish, extracting the oil, etc).

17. Dried meat.
18. Slaughter-house refuse, bones, fat and meat.

Certain of these raw materials, depending upon the kind and quality of product desired, are thoroughly mixed, ground and screened, then treated with "chamber acid "(sulphuric acid of 50° Beaumé) in the proportion of about 1 2-10 parts of acid, to 2 parts of material. The mixture is spread out to dry, ground up with other constituents, and the fertilizer is ready for shipment.

The mixing with acid evolves much heat which serves to volatilize the compounds, and the effluvia produced and set free by the reaction.

Manipulation of "Sludge Acid."—Recovery of Sulphuric Acid.

This offensive operation for recovering sulphuric acid from the "sludge" is still carried on at one establishment on the Brooklyn bank of Newtown creek near Blissville Bridge, and in direct opposition to the Governor's proclamation. [This nuisance was suppressed immediately after this report, and the proprietor was tried, convicted and fined by Judge Fisher of the Brooklyn City Court. E. H., *Secretary.*]

The manipulation of sludge acid gives rise to such ill-smelling and penetrating stenches, under favoring conditions of the atmosphere that they may extend several miles.

Fat-boiling.

The offensive process of melting and boiling refuse fat and scraps for the production of tallow, which gives rise to disgusting effluvia, contributes an important share to the general nuisance of the immediate neighborhood.

During the process of boiling the complex effluvia generated consist of volatile fatty acids, nitrogen and sulphur-compound, offensive neutral and acid substances, and when decomposing and putrefying material is used, which is often the case, to this are added the odious sulphuretted, nitrogenized and other gases resulting from the complex decomposition of animal matters.

Boiling and burning of bones.

This branch of industry is carried on at the Preston Fertilizing Company (formerly H. T. Preston's Sons), Queens county, Newtown creek, Blissville. The mode of treatment is as follows: first, boiling the bones. The bones are boiled with water for some time in covered tanks, having flues attached which lead the gases into the fire. The fat is then skimmed off and the boiling kept up for the extraction of the gelatine. The bones are then dried and sorted, the best being made into knife handles and the others into bone black. Second, burning of the bones. This is effected in covered pots which are set in long, low furnaces; when completed the black is broken up, ground, screened, and sent to sugar refineries, etc. The dust is used by fertilizer factories.

As now conducted at these works the objectionable features of the industry are greatly done away with. Constant care, however, needs to be exercised in both boiling and burning of the bones, to prevent the escape of offensive effluvia of the same chemical nature as those mentioned under the head of Fat-boiling. The storage of decomposed animal matter should be also discontinued.

Manufacture of Printing Ink.

In the district there are two ink factories. The offensive part of the process consists in the boiling of the raw linseed oil, which has to be conducted with great care and at carefully regulated temperatures. Oxygen is absorbed with the consequent elimination of carbon and hydrogen, partly as carbonic acid and water, but also with the production of volatile hydrocarbons analogous to acroleine, which are very offensive and penetrating in their effects.

The production of lamp black at Wilson's factory is also a local cause of complaint, as by careless management much smoke is produced. No means are taken by either of these manufacturers to prevent the escape of the obnoxious vapors produced in the boiling of the oil.

Manufacture of Paraffine and Lubricating Oils.

This industry may be conducted with little or no production of offensive effluvia. Proper regulations in the matter of stoking and undue exposure of distillate is however necessary. In the treatment of the heavy oils of petroleum with sulphuric acid the compound, corresponding to sludge acid in the kerosene manufacture, is without odor.

Manufacture of Varnish.

This industry is extensively carried on in the district. This may be best shown by enumerating the ten factories devoted to this industry.

Fixed oil, *volatile oil*, and *spirit varnishes* are here manufactured, also; and the *resins* employed are gums, copal, shellac, sandarac, mastic, amine, damar, Canada balsam, etc. The *solvents* employed are linseed and other drying oils, oil of turpentine, spirits of wine, wood spirits (methyl alcohol), etc.

Boiling linseed oil.—This is accomplished in open copper vessels, with addition of oxidizing substances, such as oxide of zinc, peroxide of manganese, etc., by which means the linoleine of the oil is oxidized into the tough elastic substance linoxine, and giving rise to the penetrating gases.

Manufacture of Ammonia and its Salts.

This trade, causing, as it did, the dissemination of very offensive odors, is now happily dropped from the list of producers of offensive effluvia from this aggrieved district. The Standard Chemical Co., (formally Standard Ammonia Co.), East avenue and First street, Long Island City, which were formerly engaged in the manufacture of aqua-ammonia, sulphate of ammonia, and nitrate of ammonia, thus creating by bad drainage and defective mechanical apparatus, nuisances greatly complained of, have now entirely stopped this branch of their business, and are at present only engaged in the manufacture of "chamber acid" (sulphuric acid of fifty degrees Beaumé), for the use of fertilizer factories.

Manufacture of Cream of Tartar.

This industry is carried on at the "French Cream of Tartar Co.'s,' works, Kings county, corner West and Greenpoint avenues, Brooklyn; and also at the factory on Greenpoint avenue, Blissville.

The process at the French Cream of Tartar Co. consists simply in making a hot water solution of the cream of tartar contained in the crude argols; purification of this solution with pipe clay, and subsequent crystallization and thorough washing of the resulting crystals of cream of tartar obtained. At the Blissville factory the operation is one of precipitation of the cream of tartar as a fine powder, instead of its crystallization from hot solution. The offensive effluvia are produced during the first stage of the process — namely, treatment of the argols.

Crude argols, contain beside acid tartrate of potash (cream of tartar) and tartrate of lime, considerable coloring matter, mucilaginous and other organic substances, which during solution give rise to very characteristic penetrating and offensive effluvia, which until recently were permitted to escape into the atmosphere. At the French Cream of Tartar Co.'s works, which are the largest of the kind in the United States, improvements have been instituted, which if properly adhered to will do away with this evil; but if improperly or carelessly conducted do not mitigate the cause of nuisance, but rather only serve to render the nuisance more directly felt, at least locally. By condensation apparatus and neutralization of the liquors thus obtained, by use of caustic lime, an entirely inoffensive product results, which is then run into the street sewer. However, if this neutralization is *neglected* or *carelessly conducted*, there will directly be an offensive smell in the locality, as the sewers then serve as *flues* to carry the gases directly into the houses of that region. There exists a just cause for local complaint against this evil.

Chemical Works.

Under this general head, a great variety of chemical manufacturers which have not already been mentioned, may be included, which add their share to a greater or less degree to the combined effluvia proceeding from this district, and so justly complained of by New York city's suffering citizens. The following list gives them in the order of their importance in this matter:

Roofing materials, distillers of coal tar; Factory Sixth street and East river, L. I. City.

Chemical Works: Coal-tar products, roofing and paving materials.

Acids and inorganic salts.

Dye-woods and extracts.

Bicarbonate of soda, saleratus, etc.

Standard Chemical Company : Sulphuric acid.

Silicate of soda.

Coloring material for artificial liquors.

Stannate of soda and wrought iron.

Hydrofluoric acid and tin crystals.

Respectfully submitted,

ALBERT L. COLBY, Ph. B

School of Mines, Columbia College, *Dec.* 31, 1881.

DUTIES OF THE CITIZEN TO THE STATE IN MAINTAINING PUBLIC HEALTH.*

A paper read before the Ninth Annual Meeting of the American Public Health Association, Savannah, November 30, 1881,

BY ERASTUS BROOKS, ONE OF THE STATE COMMISSIONERS OF HEALTH OF NEW YORK.

The first duty of the State is the protection of liberties of the people, the maintenance of law and order, of peace and power, and to secure, as far as possible, the lives and health of the whole people.

Among the first duties of the citizen is to aid, protect, support and uphold the State, the citizen being part and parcel of it, in the performance of all obligations to persons, communities institutions, organizations and legal authorities. To this secular obligation of common duty may be added so much of that higher law, which, quoting the words of Tillotson, declares that "religion obliges men to practice those virtues which conduce to the preservation of our health."

"Daily duties paid, hardly at first, at length will bring repose to the sad mind that studies to perform them."

With this text for what I have to say, permit me to give the reason for the faith that is in me, trusting that I may be able to prove and practice the sentiment of one of the poets, that in real life

'The primal duties shine aloft like stars."

If then the State owes order, law and protection to the citizen the citizen owes to the State, in return, allegiance, and self-preservation to himself and to those dependent upon him. The State provides schools for the young, hospitals for the sick, asylums for the deaf and dumb, for the blind, the idiotic, the insane; and poor-houses, reformatories, jails and prisons for the unfortunate and vicious class of people. The greater or lesser number in these several institutions and places depend upon the causes and conditions of those sent, or sentenced to occupy them. The State performs its duty when it provides needed comfort for the absolute poor, and needed punishment for absolute criminals. All beyond this for securing public or private good belongs to personal and responsible administration; and this is true whether the subject relates to institutions or to families. Citizens make the family; families make the State; and States and Territories compose the general government. The safe beginning will, as a rule, always make the safe end. In the State, we are not only to enjoy life, but to live nobly.

*The State Board of Health having delegated Commissioner Erastus Brooks to attend the Ninth Annual Meeting of the American Public Health Association, the following paper was presented to that body by him, and it is now placed in this Board's report as belonging to the continued discussion of the subject which Mr. Brooks presented before the Association and in the Board's First Annual Report [pp. 75-85]. E. HARRIS, *Secretary.*

Aristotle most truly said that it is only by labor that thought can be made healthy, and only by thought that labor can be made happy, and the two cannot be separated with impunity; where both are best preserved the State life and the life of the citizen will be most secure. Whoever stimulates research into questions relating to the health of the people, secures as the first fruit of that research a knowledge which benefits mankind. This knowledge is born of observation, and produces the experience which comes from observation. One of the first lessons thus learned is that governments best represent the people, and really only represent them, when those in power maintain what is wise and good, and provide punishment for what is dangerous and vicious.

The State in this sense is a civil power, a political power, a governing power of the many by the few,— the many consenting to this form of government, which means the body politic, united and organized to establish and maintain the rights, interests and welfare of the people. In a limited sense, such a government is a district, a town, a county; and these grow into a commonwealth. In a larger sense, it is a league, a confederation, and that form of federal power which most of us now call and respect as a nation. This is the imperial power of the body politic, united for all the purposes set forth in our constitutional form of government, and from which, short of revolution, there can be no dismemberment.

The first duty is the safety of the republic, and the second, and like unto it, is the promotion of the six great precepts set forth in the preamble to the Constitution; and this is true of the public health which is necessary to all domestic tranquillity, to all that belongs to the general welfare, and I may add, to justice, in the proper presentation of what is due to the people from the State.

I present this branch of what relates to popular government and duty as of the highest importance to the country and to mankind. Therefore, let the public school room, academy, college and university impart what is due to the State in return for what the State has done for them and is always doing for its children.

There should be everywhere sanitary inspections of schools, by competent local Boards of Health and of all public institutions. Among the discoveries which may be made — and I am speaking both from the school of observation and experience — is the cause and effect of those terrible diseases known as diphtheria and scarlet fever, and of all the emanations from malarial poison. Inspectors, teachers and parents, to arrest diseases like these, owe some service to the State.

I need not in this presence say just what this duty is, but for the many persons not here, I may state that among these duties are: Non-communication, isolation, safety from exposure to draughts and colds, the strict avoidance of impure water, the disinfection when required of clothing, of rooms, workshops, dwellings and of all exposed places; the special personal cleanliness of all who suffer, and of all in attendance as nurses or otherwise. Where fire and heat are not applied to get rid of what is offensive, fumes of sulphur, copperas and other effective disinfectants must be used; and when death comes there must be no public or family funeral. "The dead," if need be, "must bury their dead." To save the lives of the living by such means shows no want of sympathy for the dead or for the living, but just the contrary. One bad case of diph-

theria neglected in the school room, the sick room, or in the dead room, may lead the way to a hundred graves. The true parent, the wise friend, the honest citizen, will see that these exposures, so often caused by ignorance or false sympathy, are prevented by the strictest non-intercourse.

New York city saw 8,372 young lives lost by diphtheria alone in the six years from 1874 to 1880; Brooklyn nearly as many more, or 6,904 in the same time, and England over 1,000 in one year as far back as the year 1859. This disease is common and increasing all over our country, and in nearly all parts of the world.

What is true of diphtheria is measurably true of scarlet fever. This may not be so much of a filth disease, but it is communicated to children in the scools, and is, therefore, to be watched. Measles, whooping cough, and chicken pox are also diseases peculiar to children; and to check them, when and where they exist, or are threatend, is one of the constant duties of adults. We know, fortunately, how to arrest the spread of small-pox and the consequences of neglect.*

Not only is vaccination the first remedy, but the first duty, and as a rule, the certain cure. During its general prevalence the closing of churches, of colleges and of all schools and of all public institutions should be secured, and, if necessary, this should be the rule, if required, with all the diseases to which children are exposed.

Subjects to be learned without Direction from the State.

In infancy and early childhood nature provides the most wholesome food, and the best caretaker — including mother and nurse — is the person who studies common-sense rules as to food, raiment, warmth and ventilation. I have seen nearly 90 per cent of children, under two years of age, die in public institutions, and I have seen the lives of children of the same age and the same dependence and condition, where only 8 per cent of the whole number have died in the country nursery and hospital, and not over 14 per cent in the crowded street and city. In both town and country the good and bad results came from good or bad administration, and the good as a rule has been and always will be chiefly directed by voluntary service. Nearly as many persons die from being over-fed as under-fed, and the waste of life and the want of health in cases like these — which may be counted by thousands — is born of ignorance and indifference, for which the State is rarely responsible.

Mental training is another duty of parents and of teachers, and one hardly second in importance for the avoidance of dangers and unwise mental impressions. The brain, next to the stomach, is to be properly cared for to free children from diseases, known as fear, fright, hysteria, St. Vitus' dance, and kindred diseases, caused or suggested by unwisely directed advisors or educators. Let not wisdom linger where knowledge comes, always remembering, for young and old, that where there is cure by prevention there need be no cure by medicine.

What are called domestic pestilences — such as scarlet fever, diphtheria, measles, whooping cough, and even small-pox — are largely preventable diseases, and the remedy is, first of all, personal care, and, secondly, the

* Recently in a single ward in Chicago, where more than 1,300 persons were attacked by this malady 40 per cent of the number died.

proper use of what belongs to the atmosphere of the locality. To know yourself should in all cases mean to know how to take care of yourself, and this in the form of individual sanitation. As vaccination is the preventive of small-pox, the reasonable logic is that every man, woman and child should be vaccinated. Diphtheria, with all its mysteries, is shown to be the result of local conditions, whether propagated, as stated by Professor Horatio C. Wood, by a microscopic plant or fungi from which no one is exempt, and which exists in the mouths or throats of all of us, but with no power of reproduction until it receives fresh vitality from the disordered conditions of the mucous membrane attending sore throats produced by colds. It is a blood poison in the very sources of human blood, and even in the spleen and bone marrow. The poisoned plant extends to the blood when diphtheria sets in, and the disease goes out spreading through all possible surroundings. It is declared to be possible, if existing theories hold good, to kill this human monster by artificial vaccination, and it is at least more than possible that this terrible disease may be modified, if not removed. But as it now is, even the convalescent may communicate the worst infection; and hence the necessity for domestic purification and personal care.

We read daily how and where impure water has produced, perhaps, it should be said, aggravated diphtheria and scarlet fever.

In Memphis we have recently seen the most striking examples of wise and unwise administrations of the people. The change for the better only came after immense losses, suffering and distress; but after it came, it inspired more than a hundred towns in the country to follow one good example. For convenience at one time 10¾ miles of wooden block pavements were built in a single year, and the effect of the great wear and tear upon the streets constantly broken for repairs and fixtures produced by the constant attrition and decay, with the constant wetting of storm water, produced a fearful amount of disease. The first cause was a popular mistake in the display of a most unwise zeal in the wrong direction. The wrong done increased the mortality to a small population, or from 29 or 30 in each thousand, to 144 colored people and 92 whites. Proper sewerage or drainage, pure water, the closing up of cess-pools and vaults, restored the ordinary mortality, and the cleansing of the city reduced the death-rate two-thirds. In 1879 the population was reduced to less than 5,000 whites, and in all to little less than one-half, with a corresponding reduction in the value of every kind of property. In 1879, of 7,202 buildings in the city, 1,453 had no air space from the ground. Half of the buildings with basements and cellars had no proper ventilation. Of 4,744 wells and cisterns, 3,408 were near privy vaults, and in 6,000 of these apartments not 2,000 were properly placed or built. And just here, and all through the country, may we find the worst enemies of health and of life.

The National Board of Health, by proper remedies — aided in their good work by the best people — reduced the death-rate 20 per cent in a single year. By a like sanitation the lives and health of very many of the people of Charleston, Mobile, Galveston and Jackson were saved.

The economy of a work like this means, in time, money and work, millions upon millions saved in property, to say nothing of the saving of life and health. Of the deaths in Memphis, 15 per cent were traced to undrained soil and to deficient sub-ventilation in the homes of the

people, while 57 per cent of the total evil came from external causes, and most of all these cases were preventable by care.

Preventable Diseases.

First of all under this head is the scourge known as yellow fever, which, as nearly if not all the papers before this body prove, may be greatly modified by sanitation. Then comes small-pox and ship fever, both under easy control, and then follow all those plagues of human existence known as typhoid, enteric and scarlet fevers, malaria, diphtheria (caused by negligence), and meningetis, and measles.

In clean ships there need be neither yellow fever nor cholera. The death-rate in India, by the use of sanitary means to prevent the scourge of cholera alone, was once reduced from 22.41 to 3.29, and later to 1.26. Proper sanitation has reduced the death-rate 6 per cent in Liverpool, 3 per cent in Manchester, and in London from 1,100 in one million, to 400. Sanitation in London has also been reduced in the death-rate from 43.5 in 1685, to less than half this rate in 1880.

Facts for Personal Knowledge.

1. Carefully studied records show that typhus fever is due to a specific poison, often producing disease, which is conveyed into the human body through the agencies of bad food and polluted air, and especially, in many places, by bad well water, coming from cess-pools and like exposures. Sewer digging is another and serious source of evil.

2. Scarlet fever and scarlatina may be diminished, if not stamped out, by proper exclusions and restrictions in schools, in families, and among large bodies of people collected together. Not alone the personal presence, but even clothing not used for a year, has produced this disease.

3. Diphtheria once started increases in proportion to the neglect of sanitary conditions. Decayed vegetables, fruits, and all perishable fruits and products, if neglected, mean disease; and especially is this apparent where the soil is moist, as near swamps, marshes and immovable bodies of water. Eighty per cent of the worst cases were found at Lynn, Massachusetts, during the worst year of the disease in that locality. The fact of communicating diseases to persons, families, schools and neighborhoods from such causes is beyond dispute. Even the kissing of a friend, or the breath of a friend, may communicate diphtheria. The soil also needs watching whenever this and kindred diseases are found. Malaria is always most prevalent near the surface.

On the marshy district of an infected town on Lake Michigan filth has been traced through the ground over one hundred feet. Where it is the least visible, it is often the most penetrable. All malaria and the miasmatic fevers revel in extreme moisture.

But far more important than what is tangible and traceable are the characters and habits of the people themselves. Children are the first victims, and children can communicate diphtheria to strong mothers and stout fathers Sometimes this disease comes from natural conditions, but most frequently from positive filth. Surfaces of mud are a part of this filth, and even the sun and air may stimulate it. Though this disease is comparatively new in name, it was christened at Tours, in

France, in 1818, and is even described by Hippocrates. The new facts seem to be its propagation in the form of a microscopic plant.

4. Water used for drinking especially needs watching, and an analysis, where there is doubt or ignorance of its source or supply, is required. The transmission from wells, brooks and springs to dwellings also need watching. Even ice, with the purest surface, may be contaminated where the water is not pure. Polluted waters are rarely detected by touch, taste or smell, and only chemical and microscopic examinations can trace the real source of soil. Surface wells are dangerous and subsoil wells are undesirable. Rain water is the best of all for purity.

5. Sewer gas is another public enemy. Sulphuretted hydrogen and ammonium sulphide are found in our sewers, creating organic fetid vapors; and these, if not wholly decomposed, make them fatally foul. Even one part of these gases to two hundred and fifty of pure water, in the common atmosphere, it is said, will kill a horse, and double the quantity a dog, and only six parts small birds.

The schoolmaster who teaches whole pages of grammar, books of arithmetic, and the higher mathematics, chapters of logic and volumes of history and literature, should be requested to teach more of chemistry and physiology, of anatomy and hygiene, and even the principles of life insurance may be taught wisely, and timely. Correct speaking, calculation, reading and writing are well; but some knowledge of hygiene, of the structure of the human body, of the stomach and the brain, of the natural causes of diseases, if not their remedies, are at least of equal value. The common schools and academies teach practically little or nothing of these subjects, and even the colleges and universities but very little.

Men of all professions may become public benefactors, as from the desk and the forum they from time to time become instructors of that kind of cleanliness which is practical godliness alike on the person, in the household, and on the water and on the land.

One other source of health, depending more upon the people than the State, may be traced to tenant homes, homes such as have recently been partially begun in New York (where there are upwards of 22,000 tenement-houses), in Brooklyn, and more extensively in England, as described last month by Sir Sidney Waterlow, M. P., when visiting New York, a philanthropist who has given many years to tenement reform. In 1854 he sought to secure, in the humbler homes of the people, immunity from disease, by inspection and safety from fire, and the effect of this little more than individual effort was to reduce the average death-rate from forty to eighteen in each thousand persons, and the rate of insurance, on properly built tenant dwellings, to seven cents on each $100, with a small rental for each comfortable room during the time of occupation.

The homes of the people are the real sources of happiness, and what is best for health should be established and recognized there, and in properly constructed and regulated workshops, school-rooms and churches. In the latter physiology and physic may at times enter into that divine philosophy which teaches the ways of God to man, and in the very front rank of this intelligence should be the duty and wisdom of creating, establishing and maintaining the health of the people

The work of Florence Nightingale in England and the Crimea, in peace and in war, in the hospital and in the camp, shows what one woman can do to save life and relieve suffering. In a like spirit, in a

different field of labor, but inspired by the same divine thought, Octavia Hill, in London, possessed for long periods of time various pieces of tenement property, each one wretched in itself, and worse in the character of its inmates, and, as a lessee, visitor and friend, cleaned and repaired, made habitable and comfortable, all these hitherto miserable dwellings. In the same spirit a committee of benevolent ladies, to the great saving of health and life, have in charge as many as possible of the more than twenty-two thousand tenement houses in the city of New York.

This kind of service, much of which, and the best of which, is voluntary, has proved one of the grandest physicians of the land. At times it is seen in the direct cure of maladies, at times in the general diffusion of knowledge, and at times imparting personal comforts and positive civilization in the worst habitations of the land.

I read of the lives of 10,000 children saved in a short time in England, simply by the agencies of proper care in the use of the gifts of God to man. These agencies have been the medicine of nature, prescribed by a little practical wisdom. I read also in thirteen towns of England of a decrease of more than 17 per cent in the death rates from proper sewerage alone; but there, as here, there remains immense room for improvement. In a country like Belgium, the average lives of the cleanly and thrifty are fifty years, and of the filthy and negligent, the average length of life is only thirty-two years, and Belgium in this respect is not a peculiar country.

All of us, my friends, have many and inalienable rights; but the right of moral, physical and material contaminations of the city, the town, the country, the manufactory, the workshop, and of the dwellings of the people, are not among the rights. The State may repress nuisances, may maintain public, and as far as possible, private health; and all good citizens will not only obey the law, but as far as possible also present in their own lives and living a good example of loyalty for the many who are naturally disobedient.

The wise citizen will not only check disease in himself, but, as far as he is intelligent, avoid the necessity of calling upon a physician to cure preventable disease. Still less should the State be called upon to perform any kind of work which belongs to the citizen.

I leave it to experts and to the doctors to be specific as to the origin, character, extent and definition of diseases. As a layman I see and comprehend the effect they have upon organized communities, peoples, and large bodies of individuals. I know what foul air, impure water and bad food mean, and I would, if I could, remove them from all conditions of household and animal life. Yes, and I would, if I could, remove them from the face of the earth. I try to distinguish between abnormal decay, common to human existence, and the decay which comes from disease.

The study of chemical combinations, of biological conditions, and of epidemical relations, as a layman, I may not understand, but every one can comprehend what an epidemic is — when in the midst of it — and if he can trace it to foul water, to exposed cess-pools and other tangible offenses, the way is pointed out to remove the cause and to remove the effect of the evil. The sick animal and the sick plant, and whatever causes or enters into the decay of man must be cured, or the natural consequences follow. It is enough to know that the presence and

spread of filth means the presence and spread of disease. There may be other causes of sickness, but this one is self-evident, tangible and remedial, which may not be the fact with the class of diseases caused by air and climate and the atmosphere alone, or by diseases which only skill and study can detect and cure. In the country a belt of trees and a sheet of water, absorbing disease, have often arrested its progress.

The art of prevention in disease, as in other results, is, therefore, the best lesson for the teacher and the student. As the proverb says, "An ounce of prevention is better than a pound of cure." Even the brute creation, as in the marshes near Rome, have, through experiments, shown symptoms of malaria produced by infection of the soil and air.

These lessons are of more importance in crowded communities, and in certain climates, than in the rural districts, or where the air and atmosphere, as by the sea and on the mountains, are of the greatest purity. Every day's record from the large cities teaches us that where there is most life there is most death, even apart from great numbers of people; and much more care, therefore, is necessary to preserve life where the largest number of people are found.

It was the careful statement of your presiding officer, President Billings, last year at New Orleans, that 100,000 lives were lost each year from sheer neglect, and 200,000 cases of prolonged sickness are added during the same year. In reality the dead and the sick, who might be saved, are far beyond these figures. I will not repeat my estimates of last year as to the money and business value of each of these lives, but the loss and cost and value of each one presents a fact beyond dispute. The greatest loss is during the age of childhood; but neglect, ignorance and vice spares neither age, condition nor sex in any of the years of our lives. Of the young it was truly said by Irwin Greenhow, in a report to a general board of health, that the death rates were among the most important studies in sanitary science, because, first of all, they give a very sensitive test of sanitary circumstances; and, secondly, the places where they are most apt to die are necessarily the places where survivors are most sickly, and where, if they survive, they beget a sicklier brood than themselves, even less capable of labor and less susceptible of education. A high local mortality of youth must almost necessarily denote a high local prevalence of the causes which determine a degeneration of race. Dr. West also says the frail child never passes completely into womanhood, but fades and droops in the transition stage through which she has not the strength to pass; and this is the sad record of advancing years. We know from sad experience, how, in the State, pauperism may be perpetuated in the double form of immorality and disease.

Dr. Jarvis, of Massachusetts, in his work on the political economy of health, says that in the seven years from 1865 to 1871 72,727 died in their working period. In the fullness of health and completeness of life they would have had opportunity of laboring for themselves, their families and the public 3,006,350 years, but the total of their labors amounted to only 1,681,125 years, leaving a loss of 1,925,224 years by their premature deaths. This was an annual loss of 276,461 years of service and co-operation. Thus, it appears, that in Massachusetts, one of the most favored States of the country, and of the world, those who died within seven years had contributed to the public support less than one-half, or 46.07 per cent, of what is done in the best conditions of life. He also adds, confirming what I have already said, that it is estimated by

English observations and calculations—no notice is taken of sickness for less than a week — that for every death there are two persons constantly sick; and that means 730 days sickness and disability for every death.

In 1870 in Massachusetts, amongst the people of the working age, there were 24,554 years and eight months sickness, or disability; or just so much loss of labor.

In contrast to this sad record, let me say that upon the whole the health service of the country, and of the world, is certainly improving; but while this is true, it is necessary to add that, as an entire people, we are only in the beginning of the required work of real civilization. The death rate in the United States army from all causes is but nine per thousand of white men and twenty per thousand of colored troops.

The last annual report of Surgeon General Barnes shows that among the white troops the total number of cases of all kinds reported on the sick list was 37,408, being at the rate of 1,768 per thousand of mean strength. Among the colored troops the total number reported was 4,600, or 1,984 per thousand of mean strength. The total number of deaths from all causes among the white troops was 197, or a death-rate of nine in 1,000 of mean strength; and the total deaths of colored soldiers from all causes was forty-eight, or twenty in 1,000.

In my own State I record with satisfaction that since the establishment of the State Board of Health, as many as fifty, and at one time sixty, local Boards have been organized in a single month. They now exist in the twenty-four cities, three hundred villages, and in nearly all of the towns of the State. The cause of this improvement is due to the fact that physicians in many of the counties of the State, supported by boards of supervisors, village trustees, county, town and district clerks, and, indeed, by nearly all county officers, have been requested to co-operate with the State Board of Health in calling attention to, and in maintaining, public health at home, and to this end they were asked to respond to any and every call looking to private work, and to public meetings for the consideration and discussion of measures relating to drainage, sewerage and general cleanliness; to the ventilation of schools and public institutions; to the supplies of pure water; to the proximity of wells to cesspools and water-closets; to the adulteration of food and drugs, as affecting health, and to all general work which seeks to secure the health of the people. Work at home, as the best missionary field of labor, is the first improvement needed. The best work always begins there.

When, many years ago, Lord Palmerston met his Scotch petitioners, asking for a day of fasting and prayer, he gave them the wise but rather startling answer: "Go home, and see that your towns and cities are freed from those causes and sources of contagion which, if allowed to remain, will breed pestilence and be fruitful in death, in spite of all prayers of a united but inactive people!" And Ruskin, at a later day, declared that "any interference which tends to reform and protect the health of the masses is viewed by them as unwarranted interference with their vested right to inevitable disease and death." Yet this amiable cynic induced Octavia Hill to invest ten thousand pounds sterling of his money in the lowest quarter of the city, where she might witness the transforming power of its worth in sanitary reform. And so this noble woman, aided by Ruskin's magnificent donation of money proved that wealth is health and that health means the happiness of the people.

In this spirit, Ralph Waldo Emerson, many years ago, in his words on "One in Robust Health," said, in a spirit which I have endeavored to inculcate. "The first wealth is health. Sickness is poor-spirited; it must husband its resources to live. But health answers its own ends, and has to spare; runs over and inundates the creeks and neighborhoods of other men's necessity."

Let me prescribe one other rule of business, and for domestic and public duty; banish from your dwellings all possibilities of contamination from effete matter, all noxious and miasmatic gases from fecal decompositions resulting from soil and sewer pipes. Obstructed pipes send back into your closets, sinks and basins the foulest odors, and only the freest flow of water can keep them clear and clean.

If the sources are all pure and the road straight aud clear, there is a way of escape. The head of every house and building should be practically a health inspector. Open the doors and windows of your dormitories and school-rooms, that the air of heaven may enter therein. A little care will shut out filth and darkness, and make room for the light of heaven and the vigor of health. One marked feature of our American life is the disease known as fret and worry.

The haste and zeal of the times causes what is called "American nervousness," which means mental and physical derangement, and which, in turn, again means what has been characterized as hypotism, hysteria, catalepsy, somnambulism, and other preternatural and abnormal manifestations and hallucinations, as seen, in part, in Guiteau's villainous purpose, whatever the measure of his alleged insanity, for killing President Garfield. Some of these evils are born of deceit, passion, vanity and imposture. Others are born of intemperate lives and habits and education, and produce insomnia, dyspepsia, irritability, and a long train of nervous diseases, or disorders, characteristic of the times and the people. These are the diseases which lead the way to asylums for the idiotic and the insane, where it is so hard to—

> "Minister to the mind diseased,
> Pluck from the memory a rooted sorrow;
> 'Rase out the written troubles of the brain;
> And, with some sweet, oblivious antidote,
> Cleanse the stuff'd bosom of that perilous stuff
> Which weighs upon the heart."

The only offset to this amount of fret and worry is a corresponding reduction of inflammatory diseases; and this, it is said, is almost, if not quite in proportion to the growth of nervous irritability, and also a corresponding increase of longevity where, as one reads, diseases of the many have been most apparent.

But leaving all these specific references to life and death, disease and cure, let me return and close with a single reference as to the duty of the citizen and the obligations of the State, condensing both in the words of another: "Duty is a moral obligation imposed from within; obligation is a duty imposed from without. Duty implies a previous obligation; and an obligation involves a duty. * * * My obligation is to give another man his right; my duty is to do what is right. Hence duty is a wider term than obligation. Duty and right are relative terms. If it be the duty of one party to do something, it is the right of some other party to expect or exact the doing of it."

MODES AND EXAMPLES ON SANITARY PROCEDURE, ETC.

At the annual meeting in May, 1881, and subsequently, the Secretary was directed to prepare a circular of information upon the best methods of procedure by local sanitary authorities, under the amended laws, against nuisances and other sources of damages to public health. The Board having directed that suitable and most economical plans for contagious disease refuges should be prepared as an appendix to such circular, and that the whole be issued to all local Boards of Health and also be printed in the Second Annual Report, that document is here presented.

E. H., *Secretary.*

[No. 27.]

STATE BOARD OF HEALTH OF NEW YORK.

DUTIES AND PROCEDURES OF LOCAL BOARDS OF HEALTH AND THEIR OFFICERS.—EXAMPLES, METHODS AND SUGGESTIONS.

The laws require the Health Boards to "have cognizance of the causes of injury or danger to the public health." Full power is given every Board to make and enforce regulations and orders of *general obligation*, which shall be published and obeyed as laws; also to make *special orders*, without publication, to be immediately enforced for the suppression of nuisances and of sources of contagious diseases or other great dangers to life and health. In this circular the State Board of Health presents a practical view of sanitary procedures, as they relate to nuisances, the protection of health in schools, the removal of causes of malaria, and the control of contagious diseases. In this service, every local Board of Health is required

To be organized according to the statutes.

To have "a competent physician as Health Officer."

To adopt and publish regulations and orders of general obligation.

To prescribe "the duties and powers of the local Health Officer."

To give information to all inhabitants concerning their duties in regard to the registry of deaths, births and marriages, the burial of the dead, and the sanitary care of contagious diseases, and to designate the persons who shall grant permits for the burial of the dead.

To notify all physicians, clergymen and magistrates of their duty relating to certified records for registration.

To make and preserve accurate records of all official proceedings, and to require the Health Officer to do so in his service.

To cause every case of small-pox to be reported immediately to the local Health Officer, and to require him to report to the State Board of Health the fresh outbreaks of that contagion the day he verifies the cases; also to report to the State Board monthly.

All citizens should be free to enter complaints, and the Board should supply a form and a book for recording such complaints.

Procedures Against Nuisances.

Under the Board's instructions its Health Officer, or other qualified person, must inspect, examine evidence, and make his report to the Board, as the preliminary step to his formal complaint or an official order. Notification, official advice, and a summary or informal order may be usefully given without delay. The formal complaint and order must state that the offense is in violation of a regulation or order of the Board, or that it is "dangerous to life and detrimental to health;" or, being on or near a route of public travel, is noisome or detrimental to public health." Such specific complaints and orders will chiefly relate to scavenging and removal of filth-nuisances, disinfecting, etc., draining, and removal and prevention of obstructions; also cleansing and filling, grading, ventilating, lighting or regulating tenements and places of assemblage, the prevention of noxious emanations, etc.; the isolation and control of dangerous contagions, and the necessary interference with any other causes of imminent peril to life and health.

Illustrative Cases in Practice.*

The Board of Health in the town of V——, at its stated meeting June 25, having already adopted and published the first *eleven* sanitary Regulations as advised by the State Board of Health [*Paper* No. 26], took action as follows:—

For the removal of marshy and malarial borders of a mill-pond, seven acres in extent, in the village of M——. Upon complaint of the Health Officer and on personal inspection by the Board,

"*Resolved*,—That the Secretary serve the following notice upon Messrs. B. and A, as part owners, and on Messrs. A. B. and E. B. as part owners and lessees:— That they are hereby ordered to remove and drain the marshy borders of the mill-pond hereby declared to be a nuisance,—situated on their respective lands and under their control, on or before the 20th day of July, 1881."

For the Abatement of an Old Slaughter-House Nuisance, and for the Cleansing and Disinfection of the Building.— Upon complaint of the Health Officer, and after inspection by the Board on the 19th of June,

"*Resolved*,— That the Secretary of this Board serve the following notice upon H. S——, the owner:—

"That she is hereby ordered to remove and burn all boards, timbers and other things which are saturated with animal matter in and about the building known and used as a slaughter-house on the western border of the mill-pond marsh, on C—— street, and that the building be thoroughly fumigated, cleansed and disinfected, on or before the 20th of July, 1881."

*The examples here given have occurred during the past twelve months. The forms of procedure are such as will be found most convenient and effectual in daily sanitary service.

To Remove a Cause of Pollution of a Running Stream used for Domestic Purposes.

"*Resolved,*— That the following notice be served by the Secretary on C—— S——: That he is hereby ordered forthwith to remove or burn the dead horse which he has buried near a running stream at ——."

Complaint by Citizens, and summary Orders from the Board of Health, served by Health Officer, under the published regulations. Report of service and compliance:

COMPLAINT —

"*To the Board of Health, village* (or town) *of* ——————:

"Take notice that there is, upon the premises owned by J—— K——, and occupied by Mrs. ——, at No. —, —— street, an overflowing privy-vault; and that I hereby complain of the same as a nuisance."

"Dated ———, N. Y., this 7th day of May, 1882." "C. H., *Complainant.*"

Upon this Complaint the Health Officer indorses, and returns to the Board —

CONCERNING NUISANCE AT ——

"*To the Board of Health of* .... :

"I certify that on the 7th day of May, 1882, I received the within complaint, and that on the 7th of May I examined the premises and requested the owner to remove the contents of privy-vault. This he did *partially;* — the nuisance remaining. June 7th he was served with *notice to abate* within 3 days. June 10th it was found abated.

"(Signed) —— ——,

"(Dated) ———. *Health Officer.*"

COPY OF ORDER TO ABATE.

"*To Mr. J—— K——:*

"You are hereby required within 3 days to abate a nuisance upon your premises on ——, in —— village, viz., an overflowing privy-vault and a cesspool in front of said premises, or the same will be done, and the expense thereof collected from you, together with the penalty of neglect in relation thereto.

"By order of the Board of Health.

"—— ——,

Health Officer."

NOTE.— This order was served on owner and the tenants at the same time. It was fully complied with by J. K., the owner.

Summary Order for Abatement of Nuisance of Stagnant Water, and an old Cistern, by the Board of Health of the town of ———:

"*To* ————————————, owner and occupant of premises on the corner of I—— and W—— streets:

"You are hereby notified that the stagnant water upon your premises and bordering upon the public streets here mentioned, and an old cistern there situated, have been declared a nuisance by this Board, dangerous to life and detrimental to health. You are hereby required to abate said nuisance, within three days from the date hereof, by filling up said cistern, removing all rubbish and obstructions to drainage, and by keeping the said premises so drained, as to be free from all surface-water."

Local Sanitary Officers Obstructed.—Outbreak of Diphtheria in a Summer Resort of Families.— Notices by telegraph and mail were received by the State Board of Health announcing an outbreak of diphtheria, stating that the owner refused to comply with the sanitary requirements of the local Board of Health, and requesting inspection and advice by the State Board.

Inspection and Report by Commissioner and a Sanitary Engineer of the State Board of Health:—"Found four large buildings occupied by 300 inmates, mostly in families. It is a family resort and summer hotel. Six cases of diphtheria had occurred,— one suddenly fatal.

"*Drainage and Sewerage.*— Conducted from all directions in the basement under the largest building to a central receiving vault, which is an untrapped cesspool immediately under the center of said building. Numerous water-closets, urinals, ice-boxes, provision-chambers and pantries drain into this cesspool. The slop-sinks are untrapped; the basement floors and joists are rotten and the decayed flooring of many of the basement rooms has been torn up and laid in piles. Accumulated filth, cart-loads of rotten floorings and mud about the water-closets of the basement, endanger the inmates of the buildings. None of the closets, slop-sinks, etc., are stench-trapped. Stenches everywhere.

Ventilation.—The bath-rooms, water-closets, slop-closets and privies in each of the buildings have no ventilation excepting through the apartments in which situated. The basement and cellars are chiefly ventilated directly upward through the rarefied atmosphere of the several buildings and their corridors and promenades."

Action by the Local Board of Health.— Based upon the details of the inspection, minutely recorded, the village Board of Health immediately convened and unanimously issued its sanitary orders covering eleven specifications of work to be forthwith executed, by the owner of the property.

Remark.—In this instance the State Board provided the expert inspection upon which the orders were made and carried into execution. The first order was in the following terms: "To empty, cleanse and disinfect the great cesspool or receiving vault in the basement at the head of the main sewer and the pipes discharging into it; to remove all obstruction from the house sewers, and ventilate the receiving vault by a shaft six inches in diameter, which shall be carried above the highest point in the roof; to have flag-stones over said cesspool or vault laid air-tight in cement."

This instance illustrates the way in which a local Board of Health may appeal to the State Board. Local Boards, under the amended law, have the right to enter and examine, for sanitary purposes only, any place or premises. (See subdiv. 3 of § 3, chapter 351, 1882.)

Case of a Badly Ventilated School-house—its Cesspools returning their Gases into it.—The physicians in the town of C—— have for years quoted the enormous rate of sickness and mortality of the pupils in Public School No. 4, as evidence of unhygienic conditions that should be officially abated and prevented in and about said school-house. The local Board of Health inspected the premises, and early in December, 1881, with the aid and specifications of a sanitary engineer, instructed the school officers to close several class-rooms forthwith, and make certain changes and repairs specified in the engineer's report. Those specifications were, * * * that,—

(a.) No provision whatever exists for ventilation of the basement and first story of the building ; and, with only a single exception, the same is true of second story.

(b.) The heating apparatus derives its air supply from the basement room that is occupied as a janitor's dormitory.

(c.) The three water-closets in the basement discharge into a horizontal pipe that passes under the cellar floor, onward to the cesspools in the yard. There are hopper-closets in the yard, all unventilated and in foul condition. * * *

It is required that changes and improvements be made as follows:

(1.) *Ventilation — first story* — A board six inches wide, to be fitted close to lower sash of windows, so that sash may be raised sufficiently to admit a copious supply of fresh air between top panes of the lower and the bottom panes of upper sash, without draft across the heads of pupils. Let the windows of second story be treated in like manner; also from ceiling of centre of each room of this story conduct a galvanized iron cylinder or air-shaft, for exit of foul air, through and to a height of two feet or more above the roof. Place regulating registers at lower end of these air-shafts, flush with ceiling. Cover tops above roof with cowls.

(2.) Basement and its quarters for janitor to be vacated, and kept ventilated through-and-through.

(3.) The air-supply channels to take pure air from above, and none from basement.

(4.) Remove water-closets, and substitute suitable ones with adequate means of flushing and constant cleansing [specifications submitted]. Every closet in the house to be ventilated by shaft from trap, separately, to above the roof [specifications given]. The filthy hopper-closets in the yard to be superseded by suitable substitutes [specified].

Action by Board of Health and School Trustees — The Trustees suspended the school in those class-rooms which the Board of Health condemned, and made the improvements as specified. On the 2d of February the Board reported that the work was well executed, aud the class-rooms all fit to be re-occupied. After four months the teachers and sanitary officers report that, though overcrowded, no sickness or deaths have occurred. Trustees report that further improvements will be made during summer vacation.

Procedures Before the Courts.

The public Health act, chapter 351 of 1882, provides for three classes of cases, and suitable methods of procedure, before any court of competent jurisdiction.*

First. Under subdivision 7, section 3 of the act, the Board may issue warrants to any constable or sheriff, which shall have the force as if issued out of a court of record, and which shall forthwith be executed by said officers, for the purpose of instantly controlling causes of great

*The courts of competent jurisdiction for merely enforcing the Board's orders without waiting indictment and conviction for misdemeanor are: (1) The Board itself, for determining the facts concerning failures or refusal to obey sanitary regulations or orders, when a fine not exceeding $100 may be imposed by the Board; (2) a police justice or any justice of the peace; and, (3), any court of criminal jurisdiction for violation of laws against harm to life and health. Boards of Health may ascertain what is most expedient in law procedures by consulting the District Attorney or other competent counselor-at-law. Concerning these points the Attorney-General has stated that the remedies for violations of the health laws, and of the orders and regulations of local Boards of Health, are threefold:

danger to public health, and to apprehend and remove persons who cannot otherwise be subjected to the sanitary orders and regulations.

Second. To impose penalties directly for violations of, or non-compliance with, sanitary orders and regulations, and to maintain actions in any court of competent jurisdiction, and collect such penalties, not exceeding one hundred dollars in any one case. Also to sue for and collect the costs that have been incurred by the Board or a contractor under the Board in the execution of its order, whatever the sum may be.

Third. To bring offenders before the courts upon charges of misdemeanor, for violation of, or non-compliance with, sanitary regulations and orders, to be prosecuted and punished as provided by section 4 of the general Health act.

In all these procedures by a Board of Health, the law has fixed the nature of the offense in such manner that conviction thereof *may* be had without a formal indictment; yet in all cases of accusation of misdemeanor (as under section 4) the accused person has the right to a trial by jury, if he so elects; otherwise, *conviction* and *penalties* may be determined by any court of competent jurisdiction as respects the particular case or class of cases. All costs incurred by the Board in necessary execution of sanitary orders may be collected as provided in sections 3 and 4 of the Health act.

Sanitary Control of Infectious and Contagious Diseases; their Isolation or Quarantine.

Diseases propagated by contagion, also those caused by local conditions which should be controlled, removed and prevented, produce a large proportion of the sickness and mortality in the State.

Small-pox, diphtheria, scarlatina, typhoid fever and many other diseases are spread from house to house, and from place to place by infection. Dysentery and the diarrhœal diseases generally, malarial fevers and some other maladies are produced by local causes, which require definite action for their removal and prevention. The drainage, cleansing, drying, ventilation, etc., which are necessary to prevent disease, require sanitary inspection and suitable sanitary work.

The diseases which spread by personal infection, have to be controlled and "stamped out," by definite restraint upon the intercourse and exposure of individuals, by **separation or quarantine** of the sick

(1) Criminal proceeding. Willful violation or refusal to obey any order or regulation duly made, is, by section 4 (ch. 351, Laws 1882), and by section 397 Penal Code, made a misdemeanor, punishable by fine or imprisonment or both. Generally speaking, courts of Oyer and Terminer, and courts of sessions in counties have cognizance of these offenses; so also have certain local criminal courts in cities. The method of procedure in both the courts of Oyer and Terminer, and in the courts of sessions is by indictment.

(2) Civil proceedings for the recovery of the expenses incurred by the Board in summarily abating nuisances under section 4, chap. 351 of Laws 1882.

(3) Civil proceeding for the collection of penalties imposed under the authority of subdivision 9 of section 3.

The two latter proceedings are cognizable by civil courts having jurisdiction of the persons who are parties, and power to render judgment for the amounts demanded. Justices of the peace can give judgment to the amount of $200. County courts and the supreme court, likewise have jurisdiction, but recovery must be had to the amount of $50 to carry costs, recovery of a less amount subjecting the plaintiffs to the payment of the defendant's costs.

All of these remedies are concurrent, and can be resorted to in succession where either one proves ineffectual.

In addition to these remedies under the statutes for the enforcement of Health laws and regulations, there are also the old remedies, civil and criminal, for the abatement of nuisances, at the common law.

and of all infected things and places, and by thorough cleansing and disinfection of whatever is infected or has been exposed to contagion. Whatever is necessary in such procedures may be best illustrated by examples in practice, as here shown.

Cases and Sanitary Procedures in Practice:

Every case of small-pox, diphtheria, scarlatina, typhus or typhoid fever or other infectious malady, being,—by sanitary regulations,—in every town, city and village, *reported to the local Board of Health as soon as known*, the action taken by the physician, the family and the health officer should be,—

(1.) To separate the patient or patients, from all persons liable to take the disease.

(2.) To provide such perfect sanitary care for the sick and such prompt and complete disinfection for the apartments, clothing and other things that require disinfection, that disease shall not spread from them.

Duty of physician, householder and family.—Small-pox, diphtheria, scarlatina, typhus or typhoid fever being discovered and certified to exist in any house, the physician in attendance and the householder, or family where the disease appears, is required to give notice to the health officer, or if there is no health officer, then to the nearest member of the Board of Health, stating the name, age and circumstances of the sick person or persons. The medical attendant should at once separate the sick from all others than those who have the care of the cases, and should also carefully instruct the family concerning duties to themselves and to the sick.

Duty of Health Officer and Board of Health.—Be prepared to give specific directions, both verbally and by the printed card, showing precisely what to do, what to avoid, especially in regard to the apartments and persons where the sick are, the care and disinfection of all things that can communicate the disease, and also in regard to the rules concerning improper intercourse with and movements of the sick and whatever can convey the disease; also sanitary purification required at the termination of the case. The official card for this purpose should be placed in the hands of those in charge. The medical attendant is responsible for the duty of faithfully enforcing such rules and regulations as long as the sick and the family are under his professional care.

The sanitary authorities should direct the methods and extent of disinfection, but it is usually best to do this by the help of medical attendants, in no case, however, permitting these duties to be omitted. The official notice to the households and their medical attendants should state these rules and duties plainly and briefly. The following is a suitable form for such notice to the family or their physician or otherwise:

A——B——being sick with [small-pox] must be kept entirely separate from all persons except the appointed attendants, and no others can be allowed to remain upon the same floor of the house, unless they have had small-pox, or been successfully vaccinated within a few years. The directions given in Nos. 15, 16 and 41 of the State Board of Health papers should be faithfully followed.

The attendants, as well as the sick themselves, should be kept entirely away from all persons who are not already protected against the contagion. The attending physician, and the undersigned, will give any information desired in each case, and the official release from sanitary restrictions will be given in writing as soon as it safely can be.

By order of the Board of Health, ——————
(Signed) ——————
***Health Officer of* ————**

Quarantine and other Sanitary Orders against Contagious Disease.—Though it is presumed that the health officer and the Board of Health will, with rare exceptions, have the confidence and concurrence of the people, so that sanitary orders and instructions will be promptly complied with, the law provides suitable means for enforcing any necessary order of the local Board of Health.

An order for the isolation or quarantine of any source of dangerous contagion is absolute in its nature, and must be promptly obeyed; and under sections **three** and **four** of the Public Health Act, as amended in 1867, 1881 and 1882, it is provided that "*Every person who shall willfully violate or refuse to obey any order or regulation, . . . so made and served shall be deemed guilty of a misdemeanor,*" and by issuing its warrants to the constable, the Board may "*apprehend and remove such persons as cannot otherwise be subjected to the orders and regulations by them adopted.*" In the execution of such orders the officers are required "*forthwith to execute them, as if the same had been duly issued out of any court of record.*"

Small-pox, diphtheria, typhus, typhoid and scarlet fevers and cholera may occur under circumstances that require such prompt action. The State Board has issued special sanitary papers, **Nos. 13, 14, 15, 16, 38** and **41**, to aid health officers and families in their duty concerning these diseases.

Records of deaths and prevalent diseases.—The laws require these records to be returned to each local Board, as well as to the State Board of Health, by the health officer. Card **No. 30** has been prepared for this purpose, and is supplied by the State Board. Cards **31** and **52** are for use by the medical attendants upon small-pox and diphtheria, and are supplied by this Board to physicians through the local Board.

Temporary Quarantine,—Refuge and Hospital.—There are four ways of quickly providing a suitable refuge and hospital for contagious disease.

(1.) At home, upon the upper floor, or in any completely secluded part of the house—cleared of all occupants, except the sick and attendants.

(2.) A separate little building suitable for a Hospital Ward ready for use.

(3.) A Board Hut or a Pavilion, hastily constructed for the purpose; or

(4.) a Hospital Tent and Fly canopy. These are the safest kinds of Contagious Disease Refuge during the warm season.

The *first* is the common expedient. It is best that the entire floor, or that a separate quarter or end of the dwelling be set apart for the domestic quarantine of the sick.

The *second* is occasionally the most available and suitable method. Such a separate building should be in a healthful spot, and thoroughly ventilated.

The *third* is frequently the best method of quickly and effectually providing for any increasing number of patients. The annexed plan and specifications for a Contagious Disease Refuge and Hut, is designed to show what may be constructed in a single day to meet an emergency, such as frequently occurs in villages, alms-houses and asylums. The Hospital Tent is the best kind of refuge in the warm season, if the tent-canvas and materials are at hand. The annexed plans and directions for the Tent-Hospital will be readily understood.

These methods need no further explanation in this circular; yet as regards any method of isolation, removal, and the quarantining of contagious diseases, *we must be careful to do the sick no harm* while the people are being incited to the duty of removing and preventing the causes of disease.

The objects of this circular will be attained if health officers and Boards of Health find their duties made clear and their work facilitated by it.

Prepared and submitted by order of the State Board of Health.

ELISHA HARRIS, *Secretary.*

NOTE.—The State Board of Health having repeatedly considered the duty of advising local Boards to prepare for the refuge-care of acute contagious diseases, instructed its Secretary "to have the most suitable plans and specifications for such Refuge-Hospitals published and distributed in the form of a Circular. These specifications and plans, as seen upon the following pages, were appended to the foregoing examples and methods of procedures, and have been furnished to all local Boards and health officers in a pamphlet now known as [No. 27] in the State Series of Sanitary Papers.

[No. 27.] a

STATE BOARD OF HEALTH OF NEW YORK.

CONTAGIOUS DISEASE REFUGES:—TEMPORARY HOSPITALS

FOR

SMALL-POX AND OTHER PESTILENT CONTAGIONS.

Prepared and Distributed under Instructions from the State Board of Health,

BY THE SECRETARY.

The illustrations upon the next two facing pages present examples of the most suitable and readily erected Hospitals and Refuges for contagious diseases that need to be quarantined.

PLATE I shows Refuge-Huts, and accessories, built of wood.

PLATE II shows Refuge Tent-Hospitals.

No. 1, & A, in Plate I, show the plan of a temporary hut which can be erected and made ready for two patients in a day or night. Length, 22 feet, width, 10 feet, and height (average), 12 feet. Total cubic feet of air-space = 2,640.

This little hut or pavilion (1 & A) has four or five windows, and may be warmed by a stove. It is designed to meet the first urgent necessity for quarantining one or two patients until a larger structure (2 & B, C, D) can be erected for greater numbers, when this may be reserved for convalescents. If only two or three patients are to be so placed in Hospital this hut is sufficient. [The cost of it, at the lowest, is about $65.]

No. 2 & B, C & D, show plan of a larger structure in which from six to nine patients, with the same kind of contagious diseases can be well accommodated. Its accessory structures may be erected after the shelter for the sick is completed. This pavilion is 22 feet by 30 feet, = 660 square feet of floor-area; with a mean height of 14 feet. Total cubic space = 9,240 feet. The length may be increased at pleasure. Every 10 feet of such increase will add 3,080 cubic feet of air-space, and enough for two or three additional patients. There should be no partitions (unless deemed necessary for locked separation of sexes). The floor-screens, — C, D & G, — are the only means of separation ordinarily needed.

No. 3 (& F) is the plan of an accessory building, with shed-roof and five or six compartments. Its front line is 20 feet back from the sick ward.

No. 4 shows all that is needed for a disinfecting-room and a dead-house. (Needed in an epidemic.)

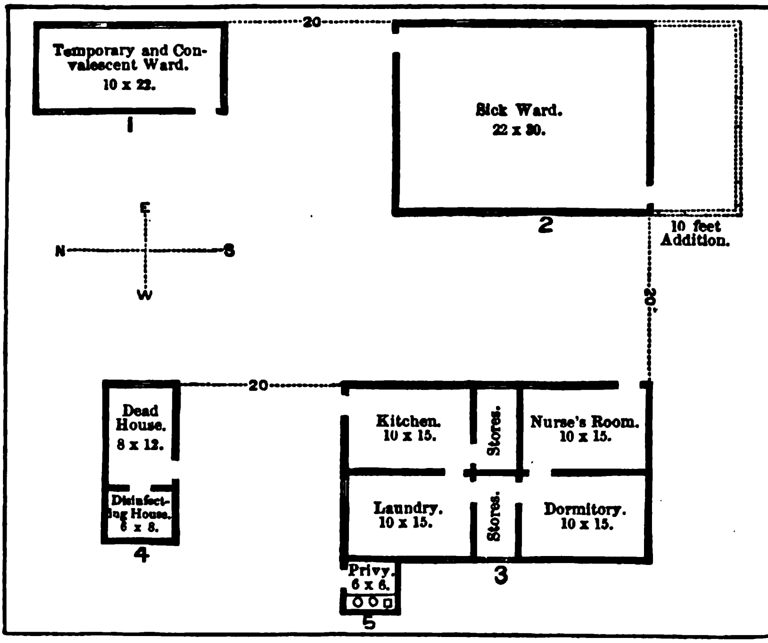
No. 5 (& E & E[1]) shows plan of privy arranged for sanitary security, at least cost, as a disinfecting and dry-earth closet. Its tubs are the halves of a kerosene barrel.

Fig. A shows south-end view of No. 1, the temporary and convalescent ward.

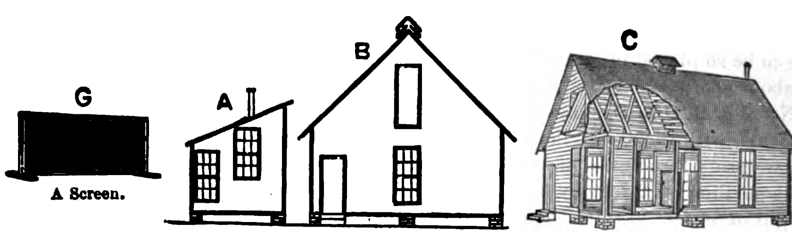
B presents a view of either end of No. 2 and C, with the end windows and one of the doors.

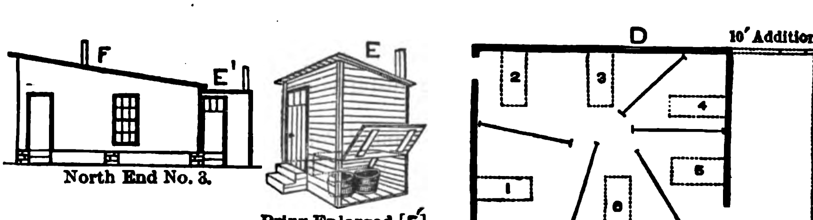
[SEE ENGRAVED PLATES ON FACING PAGES 412–13]

CONTAGIOUS DISEASE REFUGE AND HOSPITAL.



Inclosed Area, isolated, as here shown, 75 x 92 feet.
[This quarantine-ground to be extended 50 to 100 feet on each side.]

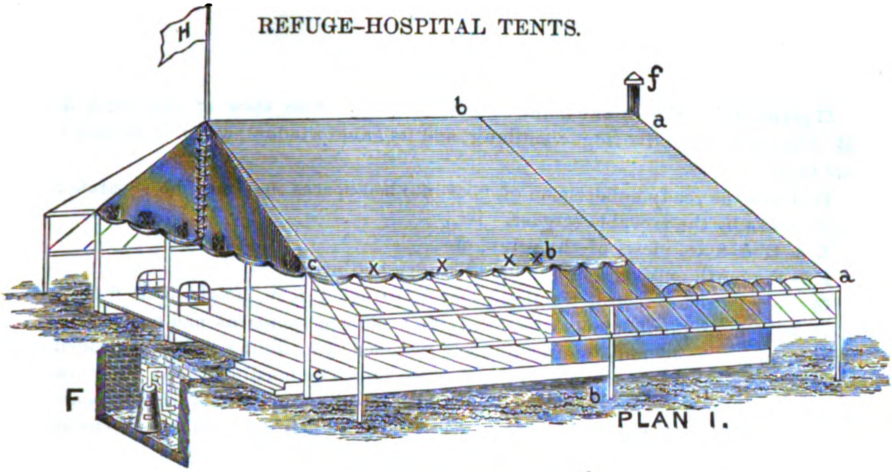


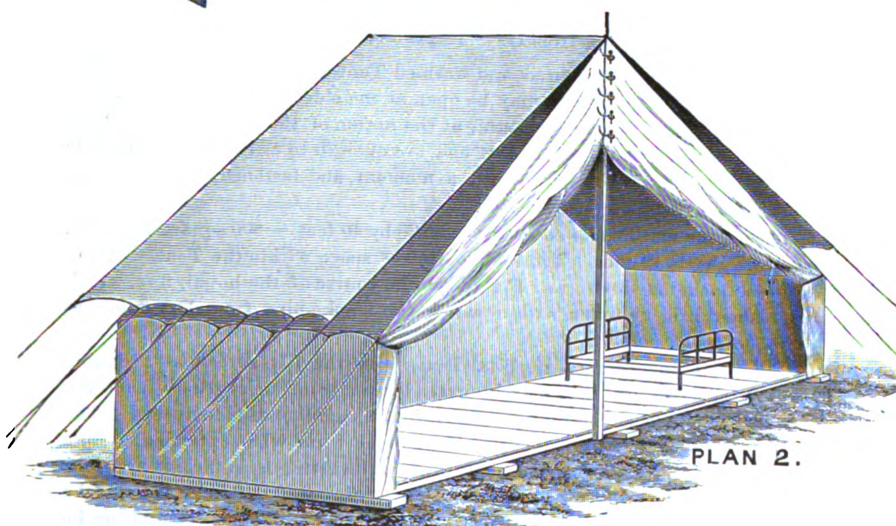


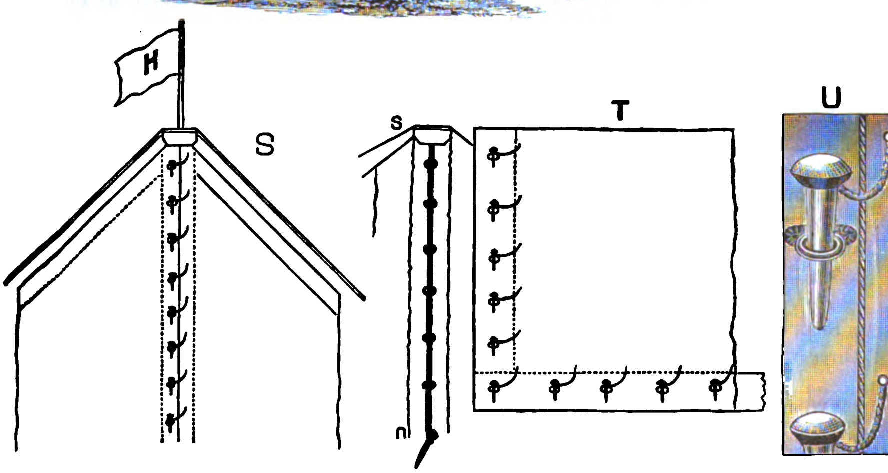
DESIGNED BY STATE BOARD OF HEALTH OF N. Y.

Del. by R. Prescott, Sanitary Engineer.

REFUGE–HOSPITAL TENTS.







Modes of Closing and Fastening Canvas.

[2d Annual Report State Board of Health of New York.]

C gives an interior (broken) and an exterior perspective view of pavilion **2 & B**. The positions of its ridge-ventilator, and its gable window swung on an axis,* are seen.

D shows the ready subdivision of floor into bed-spaces that may be separated at pleasure by the movable screens. [G.]

E & E′ & 5 are views of the privy, etc.

F is the north end-view of kitchen, laundry and privy.

G shows face and feet of a screen; length 10 or 11 feet; height 5 or 6 feet. Two flat-feet of plank-strips, with firmly fastened end standards and a cross-bar, with a face of stout muslin stretched and fastened by moulding-cleats and headed tacks*, are all that are required for such screens. The muslin may at times be used as the means of disinfecting the ward-atmosphere by the alkaline Permanganate or spirituous Thymol solutions, which may be painted upon the screens as required for evaporation, continually, or at intervals.

Refuge-Hospital Tents--Plate II.

Plan No. 1 shows a well-floored and warmed Tent-Hospital, with an extended *Fly*. The whole, or any section, may be open at the sides and ends, and any section may be completely or partly closed, at the option of the physician. As here seen the floor and sides and south-west end are open (b to c), the rolled canvas is looped up at x x x, to be let down in a moment, and fastened, to protect any section or all sides.

As here seen the tent-floor is supposed to be 20 by 40 feet, — 800 square feet area. The mean height is 12 feet. Total cubic feet of space within the Tent, — 9,600.

F shows a jacketed stove; and **F f** shows the course of the hot-air flue, which is a large sheet-iron cylinder within which the smoke-pipe from **F** extends to chimney-pipe f.

Plan No. 2 is an ordinary Hospital-Tent, with the Fly spread as a double roof; but that, or another Fly, may be extended in front (to south-east) and the extent of flooring may be doubled and the hospital capacity thus increased. The floor-area, as here seen, is supposed to be 14 by 16 feet; and when extended, — for a Fly-canopy, — it would measure 16 by 28 feet. The latter is sufficient for four or five patients and an attendant; the former for one or two. Where the materials are ready, and in good military order, this kind of Tent-Hospital can be erected and prepared in an hour from the time the grounds and floor are prepared.

S, s, & U, show the method of *fastening* the overlaying margins of canvas at the gables and sides of tents. **S & U** show the pin, ring and button-hole methods and **s** shows how to use a heavy cord with its "needle" dropped through a series of rings or staples to become a fastener.

T shows how to make, and to close, a ventilating-window in an end or side of the tent, also how to attach and fasten strips of canvas.

To erect the Tent-Hospital—Employ a man whose army experience or other knowledge and tact will serve the purpose. Second-hand canvas will answer for a Small-Pox Refuge, as the Tent must be burned as soon as out of use.

To secure dryness—Select dry and moderately elevated ground, and, if not on a rock, dig a trench two feet in depth entirely around the Tent, — within two or three yards from it, — and give it a secure outfall.

---

* Windows for *ventilation* are quickly made in the same way as the bed-screens, with unbleached muslin stretched upon frames. Half of the ward-windows, or one-half of every or any window, may thus substitute muslin for glass.

[No. 27.] *b*

STATE BOARD OF HEALTH OF NEW YORK.

Specification of Material for Contagious Disease Refuges.

(Prepared by Mr. Prescott, sanitary engineer.)

This Specification has reference to the accompanying description and plans of "Contagious Disease Refuges and Temporary Hospitals;" Second Annual Report of the State Board of Health of New York.

Plate I.

Sills. — The sills of all the buildings shall rest on posts, blocks, or stone piers, shall be accurately level, and at the corners shall be halved and spiked or pinned. The sills of Nos. 1, 2 and 3 shall be made of two 2 by 8 inch joists spiked together, so as to make a sill measuring 4 by 8 inches. The sills of Nos. 4 and 5 shall be made of two 2 by 4 inch joists spiked together, so as to make a sill measuring 4 by 4 inches.

Plates and Corner Posts. — The plates and corner posts for all the buildings shall be made of two 2 by 4 inch joists spiked together, so as to make a single piece measuring 4 by 4 inches.

If timber measuring 4 by 8 inches and 4 by 4 inches be at hand it may be used in lieu of the combination-pieces here described.

Floor Beams. — The floor beams for all buildings shall be of 2 by 8 inch stuff, and placed two feet apart and properly braced.

Rafters and Studding. — The rafters and studding for all buildings shall be of 2 by 4 inch stuff, placed not more than 2 feet 6 inches apart.

Floors. — The floors of all the buildings except Nos. 4 and 5 shall be of two thicknesses of 1¼ inch "cull boards;" the under flooring may be of second or third quality "culls," and the top flooring must be of first quality "culls." The floors must be eighteen inches, as nearly as possible, from the ground.

Siding. — The siding shall be "Novelty siding," if it can be obtained, and otherwise of clap-boarding; using culls if economy require. In Nos. 1, 2 and 3 (engraved plans) tarred paper should first be nailed to the studding, and the siding put on outside of this.

Roofs. — The roofs to be covered with shingles, if obtainable, otherwise of boards and battons. If battons are used they should be not over 3 inches wide, and laid in paint-skins.

Doors. — Battoned doors will be required, as shown in drawings [or any ready-made doors in market]. Doors to storerooms in No. 3 require locks; other doors may be provided with a simple latch.

Windows. — Windows will conform to the dimensions given, as closely as the supply in the market will afford. In No. 1, all 3 by 5 feet. In No. 2, side and lower ends, 3 by 5 feet; gable 3 by 8 feet 6 inches. In No. 3, all 3 by 5 feet. In No. 4, 3 by 3 feet, placed as high as possible. In No. 5, 1 by 2 feet. The lower sash in each window of No. 1 may be covered with muslin or sheeting, and not glazed. Any window may be thus treated. The long gable-windows in No. 2 are to swing on a horizontal axis at the center, the bottom swinging outward.

Partitions. — The partitions in No. 3 are to be of a single thickness of one-half or three-quarter inch ceiling boards, tongued and grooved.

Screens or Movable Partitions. — There will be required six screens or movable partitions, each consisting of a stout frame 11 feet long and 6 feet high, resting on a cross-piece or "foot" at each end; said foot to be 2 feet long, 6 inches wide and 2 inches thick. The frame to be covered with unbleached sheeting.

The following Table shows the Quantities of Materials needed for the Construction of the Several Buildings.

No. 1.—Temporary and Convalescent Ward.

Sills, 2x8 in. (doubled) 136 ft.
Plates, 2x4 in. (doubled) 136 ft.
Corners, 2x4 in. (doubled) 104 ft.
Floor beams, 2x8 in., 110 ft.
Studding, 2x4 inches, 286 feet.
Rafters, 2x4 inches, 110 feet.
Flooring, common culls, 1¼ in., 220 sq. ft.
Flooring, first quality culls, 1¼ in., 220 sq. ft.

Siding (Novelty), 740 sq. ft.; or clap-boards 1,110 square feet.
Tarred paper, 740 sq. ft.
Roofing boards, 242 square feet.
Shingles, 1¼ thousand.
Corner boards, etc., 1x5 inches, 168 feet.
Windows, 5, 3x5 feet.
Door, 1, 3x7 feet (as near as may be).

No. 2.—Sick Ward.

Sills, 2x8 inches (doubled), 208 ft.
Plates, 2x4 inches (doubled), 208 ft.
Corners, 2x4 in. (doubled) 104 ft.
Bearing beam, 2x8 in. (doubled), 60 ft.
Floor beams, 2x8 inches, 308 feet.
Studding, 2x4 inches, 494 feet.
Rafters, 2x4 inches, 384 feet
Flooring, common culls, 1¼ in., 660 sq. feet.
Flooring, first quality culls, 1¼ in., 660 sq. ft.

Siding (Novelty), 1,374 sq. ft.; or clap-boards, 2,061 sq. ft.
Tarred paper, 1,374 square feet.
Roofing boards, 960 square feet.
Shingles, 7 thousand.
Corner boards, etc., 1x5 in., 270 square feet.
Windows, 8, 3x7 feet; 2 swing, 3x8 feet 6 inches.
Doors, 2, 3x7 feet.

No. 3.—Administration Building.

Sills, 2x8 inches (doubled), 220 ft.
Plates, 2x4 inches (doubled), 220 ft.
Corners, 2x4 in. (doubled), 104 ft.
Bearing beam, 2x8 in. (doubled), 70 ft.
Flooring beams, 2x8 inches, 340 feet.
Studding, 2x4 inches, 611 feet.
Rafters, 2x4 inches, 308 feet.
Flooring, common culls, 1¼ in., 700 sq. ft.
Flooring, first quality culls, 1¼ in., 700 sq. ft.

Siding (Novelty), 1,268 ft.; or clap-boards, 1,902 square feet.
Tarred paper, 1,268 feet.
Roofing boards, 770 square feet.
Shingles, 5½ thousand.
Corner boards, etc., 1x5 in., 214 feet.
Partitions, ¾ in., tongued & grooved, 915 sq. ft.
Windows, 8, 3x5 feet.
Doors, 2, 3x7 ft.; 5, 2½x6 ft.

No. 4.—Dead-House and Disinfecting Room.

Sills, 2x4 inches (doubled), 104 ft.
Plates, 2x4 inches (doubled), 104 ft.
Corners, 2x4 in. (doubled), 104 ft.
Floor beams, 2x8 inches, 64 feet.
Studding, 2x4 inches, 247 feet.
Rafters, 2x4 inches, 63 feet.
Flooring, common culls, 1¼ in.. 144 sq. ft.

Siding (Novelty), 676 sq. ft.; or clap-boards, 1,014 square feet.
Roofing boards, 162 square feet.
Shingles, 1¼ thousand.
Corner boards, etc., 1x5 in., 156 feet.
Partition, ¾ inch, ceiling, 89 square feet
Window, 1, 3x3 feet.
Doors, 1, 3x7 feet; 1, 2½x6 ft.

No. 5.—Privy.

Sills, 2x4 inches (doubled), 36 ft.
Floor beams, 2x4 inches, 12 feet.
Studding, 2x4 inches, 64 feet.
Flooring, common culls, 1¼ in., 27 square ft.
Seat, etc., first quality culls, 1¼ in., 16 sq. ft.
Roofing boards, 36 square feet.
Rafters, 2x4 inch, 24 feet.

Shingles, ¼ thousand.
Siding (Novelty), 144 sq. ft.; or clap-boards, 216 square feet.
Corner boards, etc., 1x5 in., 48 feet.
Window, 1, 3 feet x 1 foot.
Door, 1, 2 feet 6 inches x 6 feet.

Summary (for all Structures in Plate I).

2x8 inches, 1,516 feet.
2x4 inches, 3,867 feet.
Common cull boards, 1,758 square feet.
First quality cull boards, 1,696 square feet.
{ Novelty siding, 4,204 square feet;
{ or clap-boards, 6,306 square feet.
Tarred paper, 510 pounds.
Roofing boards, 2,170 square feet.
Shingles, 16¼ thousand.
Corner boards, etc., 1x5 inches, 856 feet.
Windows, 3x5 feet, 13.
Windows, 3x7 feet, 8.
Doors, 3x7 feet, 7.
Doors, 2 feet 6 inches x 6 feet, 7.
¾ inch ceiling (for partitions), 1,004 sq. ft.
Nails and brads (estimated), pounds.

In addition, there will be required for No. 2 a ridge ventilator, as shown in the drawings. It may be three feet long, two feet wide and two feet high. It will be provided with a swinging-shutter on each side, made as large as possible, the bottom swinging outward.

[No. 25.][a.]

State Board of Health of New York.

ORGANIZATION, POWERS AND DUTIES OF LOCAL BOARDS OF HEALTH.

The State Board of Health invites the attention of Local Boards of Health in Towns, Villages and Cities to this recently amended statute, defining the powers and duties of Local Sanitary Officers.

AN ACT for the Preservation of the Public Health.

[**The amendment in 1881, chapter 431, Session Laws, is here printed in** *italics*. **The words in black letters have been added by the amendments made in chapter 351 — of 1882.** The other portion, in common type, comprises what remains of the original act of 1850.]

§ 1. It shall be the duty of the common council of every city *in this state, except in the cities of Brooklyn, New York, Yonkers and Buffalo, which are hereby excepted from the operation of this act, to appoint a board of* health for such city to consist of six persons who are not members of said *council, and who shall be appointed as follows: Two persons for a term of one year; two persons for a term of two years; and two persons for a term of three years; (one of whom, at least, shall be a competent physician). The mayor of such city shall be a member ex-officio of such board of health, and shall be president thereof. The said board of health, when duly organized, shall appoint a competent physician (not a member of such board) who shall be health officer for such city. This section shall not be construed to remove any of the existing boards of health in any of the cities of this state, but the successors of such boards shall be appointed as in this section provided. Upon the expiration of the term of office of any member of the board of health, appointed as herein provided, his successor shall be appointed by such common council for the term of three years, and the said common council shall also have power to fill any vacancy caused in such board of health by the death, resignation or removal from the city of any member thereof. And it shall be the duty of the trustees of every incorporated village in this state in which there is not now a board of health duly organized, to appoint once in each year a board of health for such village, to consist of not less than three nor more than seven persons (who are not village trustees), who shall hold office for one year, or until their successors shall have been appointed, from which board shall be elected a president and secretary; and the said board of health thus constituted shall appoint a competent physician to be the health officer of such village, who shall not be a member of said board of health.*

Constitution of City Boards of Health.

Health Boards of Villages.

§ 2. The supervisor and justices of the peace and the town clerk, *or a majority of them, of each town in this state, together with a citizen of such town, of full age to be elected by them, shall be the board of health for such town for each year, and they shall appoint some competent physician not a member of said board, to be the health officer for such town. They shall have cognizance of the causes of injury or danger to the public health, and shall meet upon call of the supervisor. Also, whenever in the judgment of the state board of health, or (if the said board be not in session), of the president and secretary thereof, it shall be necessary, and the public good requires it, the supervisor of such town upon reasonable notice being given him from the state board of health, or its president and secretary, shall immediately convene the town board of health, by notice to the members thereof, to take such proceedings as the public health in that vicinity may require, and concerning which it shall have been notified by the state board of health, or by its president and secretary. And in any case in which the term for which the board of health of any village or city heretofore appointed shall have expired, or in any case in which a member or several members of a board of health of any town, village or city in this state, shall resign or cease to act officially, so that less than the statutory number of members of said board continue to be members thereof, then it shall be the duty of the county judge of the county in which such town, village or city is situated, or of an adjacent county upon being satisfied that such term has expired or that such vacancy or vacancies exist, to appoint in writing a competent citizen or citizens, as the case shall require to fill such vacancy or vacancies, and to perform the duties of said office within the time specified, and until the said town, village or municipal government shall have elected*

Membership and organization of Town Boards of Health.

Temporary vacancies how filled.

or appointed the member or members, who shall, according to law, perform such official duties in the said board of health. The written appointment to a board of health, made by a county judge under this section shall forthwith be filed in the office of the clerk of the county in which said board of health is located. Any violation of the provisions of this section or of any lawful instruction of said state board of health shall be a misdemeanor.

§ 3. The several boards of health now organized in any city, village or town in this state (*except in the cities of New York and Brooklyn*), and the *several boards of health constituted under this act as amended, shall have power and it shall be their duty:*

(1.) To meet in their respective cities, villages and towns and fix and determine the period of quarantine to which vessels, vehicles or persons arriving in such city, village or town shall be subject; but the said board shall have power, after an examination, to reduce the period of quarantine of such vessel, vehicles or persons, if they deem it safe to do so.

Prescribed duties of health officer. (2.) To prescribe the duties and powers of the local health officer; to direct him from time to time in the performance thereof, and to fix the compensation he shall receive.

Powers to regulate quarantine, etc. (3.) To make orders and regulations in their discretion concerning the place and mode of quarantine, the examination and purification of vessels, boats and other craft not under quarantine; the treatment of vessels, articles or persons thereof; the regulation of intercourse with infected places; the apprehension, separation and treatment of emigrants and other persons who shall have been exposed to any infectious or contagious disease; the suppression and removal of nuisances, and all such other orders and regulations as they shall think necessary and proper for the preservation of the public health; **also to enter upon or within any place or premises where conditions dangerous to the public health are known or believed to exist and by appointed members or persons to inspect and examine the same, for the protection of life and health, and for no other purpose, and all owners, agents and occupants shall permit such sanitary examinations; and it shall be the duty of said board of health to furnish said owners or occupants a written statement of results or conclusions of such examinations.**

Local board may enter, examine and report upon any premises.

To regulate isolation of and intercourse with infected persons and places. (4.) To regulate and prohibit or prevent all communication or intercourse with all houses, tenements and places, and the persons occupying the same, in which there shall be any person who shall have been exposed to any infectious or contagious disease.

(5.) *Such board of health shall have power, and it shall be its duty, to receive and examine into the nature of complaints made by any of the inhabitants, concerning causes of danger, or injury to the public health within the limits of its jurisdiction; also to report to the state board of health, promptly, facts which relate to infectious and epidemic diseases within said jurisdiction, and to require such isolation aud quarantining of persons, vessels and sources of infection, as shall be in its judgment necessary; also to release from such isolation or quarantine, such persons, vessels and things, as it shall deem safe so to release; but upon ordering such quarantining or isolation, or such release from the same, said board and its health officers shall make a record of the facts in the case, and of the reasons for the action taken. It shall also be the duty of the said local board* to procure suitable places for the reception of persons, *and things infected with* malignant, contagious or infectious diseases, and in all cases where sick persons cannot otherwise be provided for, to procure for them medical, and other attendance and necessaries; *and it shall be the duty of every such board of health to take cognizance of, and report, every case of small-pox or varioloid, occurring within said board's jurisdiction, also to make all needful provisions for immediately obtaining the necessary means for thorough and safe vaccination of all persons within the said jurisdiction who may need the same. It shall also be the duty of the board of health in each town, village and city in this state, to have the supervision of the registration of deaths, diseases and the causes of death, and by its appointed officers, to examine all certificates and records of death, and findings of coroner's juries, and to designate the persons who shall grant permits for the burial of the dead, and to prescribe sanitary regulations for*

Board to make a report of facts and a record of its orders and acts.

To provide public vaccination.

The Board, supervision and duty of registration of vital statistics.

such burials; **and there shall be no burial of any dead person until a certificate of the death and its causes, if known, shall have been made and presented as required by the laws of this state, and until thereupon a permit for burial shall have been given as provided by said laws;** *and it shall be the duty of every such board of health to supervise and make complete the registration of births, deaths and marriages within the limits of its jurisdiction, and in so completing the said registration the cost thereof shall be a charge upon such town, village or city, and shall not exceed fifty cents for each completely verified and registered record of a birth, death or marriage, but the town clerks and the registering clerks provided by law in villages and cities may still keep all records of births, deaths and marriages as required by chapter five hundred and twelve, laws of eighteen hundred and eighty;* **and in any place in this state in which the state board of health ascertains that said registration is not completely and well made, said state board shall notify the local board of health and the registering clerk, whose duty it is to make the registration in such place, that within three months from the date of such notice, said defects and neglect in the records must be amended and prevented. If at the expiration of the time mentioned said neglect and defects are not overcome and prevented by said local authorities, it shall be the duty of the state board of health to take such control of, and adopt such means for causing compliance with rules and regulations for the said records, as will secure their completeness and proper registratien within the limit of cost hereinbefore specified, and until the said local officers shall agree to and actually make the said records and registry complete as required by law; any refusal or willful neglect on the part of any person whose duty it is to make out or file for registration any record or records as aforesaid, and any officer or board that shall neglect or refuse to register and preserve said records as required by law, shall be deemed guilty of a misdemeanor, and may be prosecuted in any court of competent jurisdiction.**

The cost per record not to exceed fifty cents.

State board shall take control to remedy neglects and enforce compliance for a time.

(6.) To publish from time to time all such orders and regulations of general obligation as they shall have made, in such mannner as to secure early and full publicity thereto; and to make, without publication thereof, such orders and regulations in special or individual cases, not of general application, as they may see fit, concerning the suppression and removal of nuisances, and concerning all other matters in their judgment detrimental to the public health, and to serve copies thereof upon any occupant or occupants of any premises whereon any such nuisances or other matters aforesaid shall exist, or by posting the same in some conspicuous place on such premises.

Orders and regulations to be published.

(7.) To issue warrants to any constable of their respective cities, villages or towns, to apprehend and remove such persons as cannot otherwise be subjected to the orders and regulations by them adopted; and, whenever it shall be necessary to do so, to issue their warrant to the sheriff of their respective counties to bring to their aid the power of the county; all which warrants shall be forthwith executed by the officers to whom they shall be directed, who shall possess the like powers and be subject to the like duties in the execution thereof, as if the same had been duly issued out of any court of record in this state.

Power to issue warrants.

(8.) To employ all such persons as shall be necessary to enable them to carry into effect the orders or regulations they shall have adopted, published and made, and the powers vested in them by this act, and to fix their compensation.

Employment of agents.

(9.*) To impose penalties for the violation of, or non-compliance with, their orders and regulations, and to maintain actions in any court of **competent jurisdiction** to collect such penalties, not exceeding one hundred dollars in any one case, or to restrain by injunction such violations, or otherwise to enforce such orders and regulations.

Boards of Health may impose and enforce penalties or restrain violations by injunctions.

* Added by § 1, chapter 559, Laws of 1870.

Violating orders of Board a misdemeanor; penalty.

§ 4.* Every person who shall willfully violate or refuse to obey any order or regulation so made and published, or any order so made and served, or posted as aforesaid, shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be subject to fine or imprisonment, or both, in the discretion of the court, such fine not to exceed one thousand dollars nor such imprisonment six months. And in any case of non-compliance with any order or regulation which shall have been so served or posted, as provided in subdivision six of section three of said act as hereby amended, the said board or its servants or employees may lawfully enter upon any premises to which such order or regulation relates, and suppress or remove the nuisance or other matters in the judgment of said board detrimental to the public health mentioned in such order or regulation, and any other nuisance or matter of the description aforesaid found there existing; and the expense thereof shall be a charge upon the occupant or any or all the occupants of said premises, and may be sued for and recovered with costs by said board in the name of such board in any court having jurisdiction. Whenever execution upon any judgment so obtained shall have been returned wholly or in part unsatisfied, said judgment, for the amount so unsatisfied, shall be a lien upon said premises, having preference over all other liens or incumbrances whatsoever. But in order to acquire such lien, such judgment, if in a court not of record, shall first have been docketed in the same place and manner as by law now required to make judgments in such courts liens upon real estate. And whenever any lien upon any premises shall have become fixed as aforesaid, the said board may cause the said premises to be sold at public auction, for a term of time, for the payment and satisfaction of such lien, and the expenses of such sale, giving notice of such sale for twelve weeks successively, once in each week, in one or more newspapers, published in the city, incorporated village or town where the premises are situated, as the case may be; or if no newspaper be published in such village or town, then in the newspaper published nearest said premises, and also serving a copy of such notice of sale personally on the owner or agent of said premises, if known, and a resident of said city, village or town, at least fourteen days previous to such sale, or by depositing the same in the post-office, directed to such owner or agent at his place of residence, if known, or the nearest post-office thereto, at least twenty-eight days previous to such sale. And the said premises shall be sold to the person who shall offer to take the same for the shortest time, paying the amount remaining unpaid upon such judgment, with interest, and the expenses of such notice and sale. A certificate of such sale, signed by the president and countersigned by the secretary of such board shall thereupon be made and delivered to the purchaser, and may be recorded in like manner and with like effect as deeds of conveyance of lands, and thereupon the purchaser, his heirs or assigns, shall be entitled to the possession of said premises so sold as aforesaid, and if unoccupied may immediately enter, and if occupied may have remedy against any occupant by action or by summary proceedings, as against a tenant holding over after expiration of his term; and in case the costs of such action or proceeding shall not be collected by such purchaser of the defendant therein, the same shall be a lien upon said premises, having the like preference as the lien aforesaid, and the term of the said purchaser shall be extended during a time bearing the same proportion to the original term as the amount of such cost bears to the amount paid by such purchaser on such sale. And such term shall commence when such purchaser shall have acquired possession. At any time after such sale, and within six months after the recording of such certificate as aforesaid, the owner or any lienor or incumbrancer of such premises, or of any part thereof, may redeem by paying to the purchaser the amount paid by him on such sale, and all costs and expenses he may have incurred in any action or proceeding as aforesaid to obtain possession, with ten per cent interest thereon. If such redemption be made by the owner, the right of the purchaser shall be extinguished; and if such lienor or incumbrancer, the amount paid by him to redeem shall be added to his lien or incumbrance, or if he have more than one, to the oldest, and shall thenceforth partake of the nature thereof and be collectible by any remedy adapted thereto.

Power to enter upon premises and suppress nuisance.

Unsatisfied judgment to be a lien upon the premises.

Sale of premises at auction.

Certificate of sale.

* As amended by chapter 790, Laws of 1867. Only when the regulation has been made and published can conviction be had for its violation. Reed v. People, 1 Park, Cr. R. p. 481.

§ 5.* All expenses incurred by the several boards of health **under their official orders or regulations, or under requirements of the statutes,** in the execution and performance of the duties imposed by this act shall be a charge only on their respective cities, villages and towns; and shall be audited levied, collected and paid in the same manner as other city, village and town charges are audited, levied, collected and paid. Expenses of Boards of Health to be a town, village or city charge; how audited and paid.

§ 6. Whenever any **pestilential**, or infectious or contagious disease shall exist in any county poor-house in this State, or in the vicinity of any such county poor-house, and the physician of such county poor-house shall certify that such pestilence or disease is likely to endanger the health of the persons supported at such poor-house, the superintendent of such county poor-house shall have power to cause the person supported at such poor-house, or any of them, to be removed to such other suitable place in the same county as shall be designated by the board of health of the city, town or village within which such poor-house shall be, there to be maintained and provided for at the expense of the county, with all necessary medical care and attendance, until they shall be safely returned to the county poor-house from which they were taken, or otherwise discharged. Persons sick of infectious disease may be removed from county poor-house.

§ 7. *In any instance in which there is a legally organized board of health in an incorporated village, which comprises parts of several towns, or less than a whole town, such board of health shall have full authority in regard to all matters relating to public health within said village, and such village which has its own organized board of health shall not be subject to the sanitary regulations or health officers of the township or towns within which such village is located; nor shall the taxable property of any such village, while maintaining its own board of health be subject to taxation for maintaining any town board or boards of health, or for any expenditures authorized by such town boards; but such expenditures of the town boards of health shall be assessed and collected exclusively on property in the town outside of said village.* Village Boards and Villages not to be taxed to support town sanitary improvements, nor towns to support Village Boards of Health and their works.

§ 8. All acts and parts of acts inconsistent with this act are hereby repealed.

Other Statutes relating to Public Health.

Protection against Small-Pox.—Vaccination of School Children.—Chapter **438** of the Laws of 1860, is an *obligatory* law providing for the vaccination of all attendants at the public schools. An abstract and explanation of it are given in No. **41** of the printed Papers of this Board.

Prevention of Adulteration of Food and Drugs.—Chapter **407** of 1881, forbids adulteration of Foods and Drugs. The State Board of Health is required to conduct analytical investigations, and give practical effect to this statute.

Safety-Testing and fixed Standards to prevent dangerous use of Explosive Illuminating Oils.—By Chapter **292** of the Laws of 1882 the use of Petroleum products which give off an explosive vapor at a temperature below 100° Fahr., as tested by methods and instruments approved and directed by the State Board of Health, is prohibited. The State Board is charged with the administration of this statute.

Adulteration and Deception in regard to Milk as sold to Customers.—By Chapters **544** of 1864, **220** of 1878, and **407** of 1881, every kind and mode of adulteration and deception in Milk is prohibited. Local boards of heath, as well as persons aggrieved or cognizant, may bring action in court to secure infliction of penalties.

To provide for Public Drainage of Swamps and Wet Lands for Protection of the Public Health.—Chapters **888** of 1869, **303** of 1871, and **243** of 1873, provide ways and means for securing public drainage wherever public health and a Commission judicially appointed demand such general drainage works.

The organic Act creating the State Board of Health and defining the powers of the Governor and the Board.— Chapters **322** of 1880 and **308** of 1882.

---

*As amended by chapter 761, Laws of 1868, and chapter 351 of 1882.

AN ACT TO ESTABLISH A STATE BOARD OF HEALTH.

CHAPTER 322, LAWS OF 1880.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

State Board of Health, how constituted.

SECTION 1. Within twenty days after the passage of this act the governor shall appoint, by and with the advice and consent of the senate, three State commissioners of health, two of whom shall be graduates of legally constituted medical colleges and of not less than seven years' practice of their profession. The said commissioners, together with the attorney-general, the superintendent of the State survey and the health officer of the port of New York, who shall be ex-officio members of the State Board of Health, and three other persons to be designated and appointed by the governor, one of whom shall be a commissioner of health of the Board of Health, of the city of New York, and the others shall be members or commissioners of health of regularly constituted and organized Boards of Health of cities of the State, shall constitute the Board of Health of the State of New York. Nothing in chapter three hundred and thirty-five of the laws of eighteen hundred and seventy-three of the State of New York or in the laws amending the same, or in the laws constituting Boards of Health in the various cities of the State, shall be read or construed to prevent the appointment of the said commissioners of Board of Health of cities also members of the Board of Health of the State of New York, and no appointment to an office, or acceptance thereof under this law, shall be held to vacate the office previously held in any Board of Health of any city in the State.

Oath of commissioners. Term of office. Vacancies, how filled.

§ 2. The said three commissioners so appointed shall take the oath of office prescribed by the constitution for State officers, and receive from the secretary of State certificates of their appointment. They shall hold office for three years, and whenever a vacancy occurs, the place shall be filled as in other cases provided by law, and the other commissioners shall, from time to time, be designated by the governor as occasion may require, or as their places may be vacated in the Board by the expiration of the several terms of office.

Meetings of board. Traveling expenses, etc., of commissioners to be paid.

§ 3. The State Board of Health shall meet at least once in every three months and as much oftener as they shall deem necessary, their first meeting being held in the city of Albany within two weeks after the appointment duly made of the members of the first Board and after they shall have qualified as aforesaid, and each annual meeting shall be held within two weeks after the first of May each year after the first as herein provided. No member of the Board except the secretary shall receive any compensation, but the actual traveling and other expenses of the members and officers of said Board while engaged in their duties shall be allowed and paid out of the appropriation made for its support. They

shall elect annually one member of the Board to be president; they shall also elect from among their own members or otherwise, a person of skill and experience in public health duties and sanitary science, to be the secretary and executive officer of said Board, who shall have all the powers and privileges of a member of the Board except in regard to voting upon matters relating to his own office and duties as secretary, and he shall hold said office for the term of three years, but he may be removed for cause after a full hearing by the Board, a majority of the members voting therefor.

President to be annually elected. Secretary to be executive officer, and to hold office three years.

§ 4. The State Board of Health may adopt by-laws regulating the transaction of its business, and provide therein for the appointment of committees to whom it shall delegate authority and power for the work committed to them, and it may also adopt and use an official seal. Five members shall constitute a quorum for the transaction of business.

Board may adopt by-laws. Seal. Quorum.

§ 5. The secretary shall keep a record of the acts and proceedings of the Board, perform and superintend the work prescribed in this act, and such other duties as the Board may order, and shall receive an annual salary of three thousand dollars, which shall be paid him in the same manner as the salaries of other State officers are paid, and such necessary expenses shall be allowed him as the comptroller shall audit on the presentation of an itemized account having vouchers annexed, together with the certificate of the Board.

Duties and compensation of secretary.

§ 6. Said Board shall take cognizance of the interests of health and life among the people of the State, they shall make inquiries in respect to the causes of disease, and especially of epidemics, and investigate the sources of mortality, and the effects of localities, employments and other conditions upon the public health. It shall be the duty of said Board to obtain, collect and preserve such information relating to deaths, diseases and health as may be useful in the discharge of its duties, and contribute to the promotion of the health or the security of life in the State of New York. And it shall be the duty of all health officers and Boards of Health in the State to communicate to said State Board of Health copies of all their reports and publications; also such sanitary information as may be useful.

General duties of Board.

§ 7. It shall be the duty of the State Board of Health to have the general supervision of the State system of registration of births, marriages and deaths, and also the registration of prevalent diseases. Said Board shall prepare the necessary methods and forms for obtaining and preserving such records, and to insure the faithful registration of the same in the several counties, and in the central bureau of vital statistics at the capitol of the State. The said Board of Health shall recommend such forms and amendments of law as shall be deemed to be necessary for the thorough organization and efficiency of the registration of vital statistics throughout the State. The secretary of said Board of Health shall be the superintendent of registration of vital statistics of the State. As supervised by the said Board, the clerical duties and safe keeping of the bureau of vital statistics thus created shall be provided for by the comptroller of the State, who shall also provide and furnish such apartments and stationery as said Board shall require in the dis-

Board to have supervision of vital statistics of State, and to recommend necessary legislation.

Board to prepare forms for, and regulate use of, transfer permits.

charge of its duties. And the State Board of Health shall also prepare the necessary methods and forms and prescribe the rules regulating the issue and use of transfer permits, with the proper coupons attached thereto, to be issued by local organized Boards of Health, for the transportation of the dead bodies of persons which are to be carried for burial beyond the limits of the county where the death occurs; and in all cases, the State Board of Health shall require coupons to be attached to such permits, to be detached and preserved by every common carrier, or the person in charge of any vessel, said railroad train or vehicle to whom such bodies shall be delivered for transportation. Any violation of such rules and regulations shall be a misdemeanor.

Violation of regulation a misdemeanor.

Governor may require Board to examine and report on nuisances, etc. Report, where to be filed.

§ 8*. At any time the governor of the State may require the State Board of Health to examine into nuisances affecting the security of life and health in any locality, and in such cases, said Board of Health shall have all necessary powers to make such examinations, and it shall report the results thereof to the governor, within the limits of time prescribed for such examination and report. The report of such examination, when approved by the governor, shall be filed in the office of the secretary of State, and the governor may, in relation to things found and certified by the said Board of Health to be nuisances, declare them to be public nuisances, and order them to be changed, as he shall direct, or abated and removed. And such order shall be persumptive evidence of the existence of such nuisance, and all persons maintaining, or assisting to maintain, or aiding and abetting, in any manner, in the maintenance of such nuisance, after notice of such order, shall be guilty of a misdemeanor, punishable by fine not to exceed one thousand dollars, or imprisonment in the county jail of the county in which such nuisance is maintained, not to exceed one year, or by both such fine and imprisonment. In such cases, when such order has been made, the governor may, by his further order in writing, certified under his official seal, require the district attorney, the sheriff, and the other officers of every such county to take all necessary measures to execute and to obey the order of the governor; and any act of any such county officers in the abatement of any such nuisance, so declared, which shall be reasonable or necessary for the execution of such purpose, shall be lawful and justifiable, and the order of the governor shall be their protection. The expense of the abatement of such nuisance shall be paid by the county in which such nuisance occurs, and such expense shall be a charge or a lien upon the lands maintaining such nuisance, and shall be a valid claim on behalf of said county against all persons maintaining the same, or assisting in the maintenance thereof; and the lien and claim thus created may be collected by action to recover against either or all of the persons liable to pay the same, and may also be enforced by action to enforce the lien upon the lands maintaining the nuisance, by a sale thereof, to satisfy the same.

Governor may order nuisances abated.

Violation of order a misdemeanor.

Dist. attorney, sheriff and other county officers to cause the execution of the governor's orders.

The county to be responsible for costs, which shall be a lien on property of offenders.

---

*As amended by chapter 308, Session Laws of 1882.

§ 9. At any time at the request of the State Board of Health, or whenever the governor shall, as hereinbefore provided, have directed an examination and report to be made by the State Board of Health into any alleged nuisance, any Board of Health of any city of the State may appoint and select any one of its officers as its representative, during such examination of any nuisance, and such representive officer shall have a seat at, and be entitled to take part in, all the deliberations of the State Board of Health, during such investigation, but without the right to vote.

When local Boards to be represented at deliberations of State Boards.

§ 10. Said Board may, from time to time, engage suitable persons to render sanitary service, and to make or supervise practical and scientific investigations and examinations requiring expert skill, and to prepare plans and report relative thereto. And it is hereby made the duty of all officers and agents having the control, charge or custody of any public structure, work, ground or erection, or of any plan, description, outlines, drawings or chart thereof, or relating thereto, made, kept or controlled under any public authority, to permit and facilitate the examination and inspection, and the making of copies of the same by any officer or person by said Board authorized; and the members of said Board, and such other officer or person as may at any time be by said Board authorized, may, without fee or hindrance, enter, examine and survey all grounds, erections, vehicles, structures, apartments, buildings and places. But no more than five thousand dollars in any one year shall be expended for such special sanitary service.

Board may employ experts and examine structures and places.

Limitation of amount to be expended for expert service.

§ 11. It shall be the duty of said Board, on or before the first Monday of December in each year, to make a report in writing to the governor of the State, upon the vital statistics and the sanitary condition and prospects of the State; and such report shall set forth the action of said Board and of its officers and agents, and the names thereof, for the past year, and may contain other useful information, and shall suggest any further legislative action or precautions deemed proper for the better protection of life and health. And the annual report of said Board shall also contain a detailed statement of the comptroller of all money paid out by or on account of said Board, and a detailed statement of the manner of its expenditures, during the year last past, but its total expenditures shall not exceed the sum of fifteen thousand dollars in any one year.

Time of annual report.

§ 12. The sum of fifteen thousand dollars is hereby appropriated from the general fund for the purposes of this act, and the expenditures properly incurred by authority of said Board and verified by affidavit, subject, however, to the limitations hereinbefore imposed, and shall be paid by the treasurer upon the warrant of the comptroller.

Appropriation for expenses.

§ 13. This act shall take effect immediately.

REPORTS BY THE SANITARY COMMITTEE.

The Sanitary Committee of which Prof. C. F. Chandler, Ph. D., LL.D., is chairman, having the special supervision of chemical and other laboratory examinations, has presented the following reports:

1. *Chemical examination of drinking waters.*

2. *The methods and apparatus for testing inflammable oils.*

3. *The report upon adulterations of food and drugs, as provided by the new law to prevent the adulteration of food and drugs.*

REPORT ON

THE CHEMICAL EXAMINATION OF DRINKING-WATERS,

By Elwyn Waller, Ph. D.
School of Mines, Columbia College.

To the State Board of Health:

I have the honor to present herewith the results of my examinations of the various samples of water taken from suspected sources of public or private supplies during the past few months. A brief explanation of the meaning and importance of the tests and methods I have used will be found annexed to the following tabulated statement of results of these analyses:

Descriptive List of Samples.

Sample marked.		Date Received.	Information regarding the sample.	From.
Rome,	No. 1.	July 25th.	Inside driven well, Academy basement.	A. C. Kessinger.
do	No. 2.	do	Outside dug well, roofed over, wooden pump, Liberty street school.	"
do	No. 3.	do	Inside driven well, Thomas street school basement.	"
do	No. 4.	do	City water (Mohawk and Black rivers).	"
do	No. 5.	do	Inside driven well, James street school basement.	"
Watertown,	No. 1.	do	Delano's Falls, 2 miles above the city.	J. M. Adams.
do	No. 2.	do	From old supply, forced into mains by pumps.	"
do	No. 3.	do	Well water.	"
West Troy,	No. 1.	Aug. 9th.	By dam near outlet chimney.	Dr. R. H. Sabin, Health Officer.
do	No. 2.	do	Back of the slaughter-house.	
do	No. 3.	do	From drinking fountain in the village.	"
do	No. 4.	do	Inlet of reservoir from Mohawk river.	"
Southampton, L. I.,	No. 5.	do	Well of No. 5. State Board of Health report, p. 152.	Dr. P. Brynberg Porter,
do	No. 7.	do	Well of No. 7. State Board of Health report, p. 152.	"
do	No. 9.	do	Well of No. 9. State Board of Health report, p. 152.	"
do	No. 10.	Aug. 13th.	Well of No. 10. State Board of Health report, p. 152.	"
do	"Lee"	do		
do	No. 4.	Aug. 16th.	Well of No. 4. State Board of Health report, p. 152.	"
do	X	Sept. 6th.	Drive well on the beach.	"
do	XX	do	Well of Mr. J. H. Piesm.	"
do	XXX	do	Well of Mr. W. Pithtnau.	"
Batavia,	No. 1.	Sept. 15th.	From 62 State street.	Dr. C. Houghton,
do	No. 2.	do	From 27 Ellicott street.	"
do	No. 3.	do	From Ross street.	"
West Hampton,	No. 1.	do	From well.	C. F. Chandler, Ph. D.
do	No. 2.	do	From well.	
do	No. 3.	Sept. 27th.	From well.	"
Schaghticoke,	No. 1.	Sept. 17th.	Well in lower part of the village (30 feet depth).	Dr. Crombie.
do	No. 2.	do	Well in upper part of the village	"
Lockport,	No. 1.	Sept. 24th.	Canal, above locks, nearly outside city limits.	"
do	No. 2.	do	Union school well.	Dr. W. J. Ransom,
do	No. 3.	do	Well East Lockport (or lower town).	"
Cortland village,	No. 1.	Sept. 29th.	Well.	Dr. F. Hyde.
do	No. 2.	do	Well (much sickness in the neighborhood).	"
				"
Cazenovia.	No. 1.	Oct. 24th.	Well much used in village.	Dr. J. N. Goff.
do	No. 2.	Oct. 22d.	do do do	
Hamilton,	No. 1.	Nov. 15th.	From drive well used in bread and cracker baking by a hotel (privy 30 feet off). Another privy 30 feet off. Cess-pool 24 feet off.	Dr. F. D. Beebe.
do	No. 2.	do	Dug well, public school, 20 feet deep (66 feet from privy).	"
Croton Falls,	No. 1.	Nov. 23d.	O'Neil well.	Dr. J. E. Wood.
do	No. 2.	do	Michael Wood's well.	
do	No. 3.	do	R. Smith's well.	"

Conclusions According to Standards of

Sample.		Wanklyn.	Tidy.	Ekin.	Soc. Pub. Anal.	Remarks.
Rome,	No. 1.	Good.	Good.	Good.	Good.	
do	No. 2.	Good.	Good.	D'btf'l.	Good.	Suspicion of previous sewage contamination.
do	No. 3.	Good.	Good.	Good.	Good.	
do	No. 4.	Good.	Bad.	Good.	Unsat.	Probable vegetable contamination.
do	No. 5.	Bad.	D'btf'l.	Unsat.	do	Suspicion of recent sewage contamination.
Watertown,	No. 1.	Fair.	Bad.	do	Bad.	Probable vegetable contamination.
do	No. 2.	Fair.	do	do	Bad.	do do do
do	No. 3.	Good.	Good.	Good.	Good.	
West Troy,	No. 1.	Bad.	Bad.	Bad.	Bad.	Probable animal contamination.
do	No. 2.	Bad.	Bad.	Bad.	Bad.	do do do
do	No. 3.	Bad.	Bad.	Bad.	Bad.	do do do
do	No. 4.	Fair.	Unsat.	Unsat.	Unsat.	
Southampton,	No. 5.	Bad.	Unsat.	Bad.	do	Infiltration of sewage probable.
do	No. 7.	Bad.	do	do	Fair.	do do do
do	No. 9.	Bad.	do	do	Unsat.	do do do
do	No. 10.	Good.	Good.	Good.	Good.	
do	"Lee"	Good.	Good.	Good.	Good.	
do	No. 4.	Fair.	Good.	Fair.	Good.	
do	X	D'btf'l.	Unsat.	D'btf'l.	Bad.	Recent sewage probably present.
do	XX	Bad.	Fair.	Bad.	Bad.	do do do do
do	XXX	Bad.	D'btf'l.	Bad.	Bad.	Sewage probably present.
Batavia,	No. 1.	Good.	Good.	Fair.	Good.	
do	No. 2.	Unsat.	Fair.	Unsat.	Bad.	Solids objectionable, suspicious.
do	No. 3.	Bad.	Bad.	Bad.	Bad.	
West Hampton,	No. 1.	Fair.	Unsat.	Fair.	Good.	
do	No. 2.	Fair.	Unsat.	Fair.	Good.	
do	No. 3.	Unsat.	Unsat.	Bad.	Unsat.	Slight suspicion of previous sewage contamination.
Schaghticoke,	No. 1.	Bad.	Bad.	Bad.	Bad.	
do	No. 2.	Unsat.	Fair.	Bad.	Bad.	
Lockport,	No. 1.	Bad.	Unsat.	Bad.	Bad.	
do	No. 2.	Unsat.	Fair.	Bad.	D'btf'l.	
do	No. 3.	Fair.	Fair.	Fair.	Bad.	Excessively hard.
Cortland village,	No. 1.	Good.	Good.	Good.	Good.	
do	No. 2.	D'btf'l.	Bad.	D'bif'l.	Bad.	Possibly vegetable contamination.
Cazenovia,	No. 1.	D'btf'l.	Bad.	Bad.	Bad.	
do	No. 2.	Good.	Good.	Good.	Good.	Turbidity and mineral matter objectionable.
Hamilton,	No. 1.	Fair.	Good.	Bad.	Good.	Suspicion of sewage percolation.
do	No. 2.	Good.	Good.	Good.	Good.	Hardness objectionable.
Croton Falls,	No. 1.	Fair.	Good.	Good.	Good.	
do	No. 2.	Good.	Good.	Good.	Good.	
do	No. 3.	Good.	Good.	Good.	Good.	

Explanation of certain terms employed in the Descriptions.

A water is designated *good* when, from what can be learned by the examination or a knowledge of the location of its source, there is no satisfactory ground for condemning it.

As *fair*, when it cannot be considered as first class, but still can probably be used with safety.

As *unsatisfactory*, when the indications are suspicious, and it is advisable only to use it so long as another supply cannot be obtained.

As *doubtful*, when the indications are still more suspicious, and it is deemed advisable to avoid its use.

As *bad*, when it should not be used under any circumstances whatever for household purposes.

ANALYSIS OF WATER.

Results in parts per hundred thousand.

Sample marked.	Appearance — color.	Odor when heated to 100° Fahr.	Chlorine in chlorides.	Equivalent to sodium chloride.	Phosphoric acid in phosphates.	Nitrogen in nitrates & nitrites.	Free ammonia.	Albuminoid ammonia	Oxygen absorbed at 80° Fahr.		Hardness equivalent to carbonate of lime.		Organic and volatile matter.	Mineral matter.	Total solids dried at 230° Fahr.	Conclusions.	Analysis number.
									In two minutes.	In three hours.	Before boiling.	After boiling.					
Rome No. 1	Clear, light bluish green	Slight	0.877	1.445	None	0.2525	0.0004	None	None	0.0054	19.230	3.715	1.500	22,90	24.40	Good	1
do No. 2	do do	do	2.245	3.699	Slight trace	0.5771	0.0002	0.0004	do	0.0016	19.670	7.868	Trace	36.60	36.60	Fair	2
do No. 3	do do	None	1.333	2.196	do	0.3376	None	0.0006	0.0016	0.0016	14.000	3.934	1.700	25.30	27.00	Good	3
do No. 4	Slightly turbid, yellow	Earthy	0.140	0.231	Trace	0.0280	0.0010	0.0074	0.0640	0.2463	7.200	5.682	0.660	8.20	8.80	Not completely satisfactory	4
do No. 5	Yellowish green	Faint	5.401	8.902	do	0.0367	0.0004	0.0120	0.0280	0.2039	41.310	6.120	3.800	71.00	74.80	Unsatisfactory	5
Watertown No. 1	Turbid, brownish	Earthy	0.105	0.173	do	0.0145	0.0024	0.0066	0.0976	0.3872	5.900	5.464	1.000	6.50	7.50	Unsatisfactory	6
do No. 2	Turbid, yellowish brown	do	0.053	0.087	do	0.0235	0.0014	0.0080	0.0912	0.3754	6.775	5.245	0.900	6.20	7,10	Unsatisfactory	7
do No. 3	Clear, light bluish green	Slight	9.294	15.318	None	0.0107	0.0020	0.0050	None	0.0255	13.330	3.060	Trace	37.40	37.40	Good	8
West Troy No. 1	Turbid, brownish yellow	Of stable	0.351	0.578	Heavy trace	0.0318	0.0114	0.0123	0.0960	0.2688	8.030	3.880	2.200	14.80	17.00	Bad	9
do No. 2	Turbid, yellow	do	0.316	0.520	do	0.0283	0.0196	0.0678	0.0810	0.2912	6.940	3.500	0.500	15.10	15.60	Bad	10
do No. 3	Turbid, brown	do	0.351	0.578	do	0.0054	0.1194	0.0252	0.0710	0,2240	8.740	3.990	0.400	16.10	16.50	Bad	11
do No. 4	Slightly turbid, yellow	Earthy	0.351	0.578	do	0.0112	0.0024	0.0076	0.0704	0.2092	8.740	4.260	Trace	16.00	16.00	Unsatisfactory	12
South'pton No. 5	Clear light blue	do	4.210	6.940	do	0.7560	0.0070	0.0140	0.0269	0.1356	15.640	7.160	4.800	36.00	40.80	Doubtful	13
do No. 7	Light green	None	4.900	8.090	do	0.1155	0.0048	0.0112	0.0237	0.1373	5.840	3.820	2.800	16.90	19.70	Doubtful	14
do No. 9	Clear light blue	do	4.033	6.647	Trace	0.6209	0.0060	0.0178	0.0269	0.1232	9.800	8.800	5.000	40.00	45.00	Bad	15
do No. 10	do do	do	1.578	2.600	None	0.2633	0.0002	0.0022	None	0.0008	2.079	1.980	2.100	7.30	9.40	Good	16
do "Lee"	do do	do	2.630	4.335	do	0.0412	None	0.0030	do	0.0016	1.485	1.386	2.700	5.70	8.40	Good	17
do No. 4	do do	do	4.208	6.936	do	0.2470	do	0.0105	0.0009	0.0165	13.068	2.574	Trace	30.50	30.50	Bad	18
do x	Turbid, yellowish green	do	62.430	102.890	Trace	None	0.2780	0.0030	0.0478	0,1330	27.720	23.760	19.50	137.30	156.20	Bad	22
do xx	do do	do	4.384	7.225	Faint trace	1.2176	0.3460	0.0092	0 0378	0.0953	5.742	5.742	10.00	25.00	35.00	Bad	23
do xxx	do do	Slight	4.209	6.936	None	0.7016	0.0280	0.0245	0.0360	0.1780	11.088	7.326	16.00	38.80	54.80	Good	24
Batavia No. 1	Clear, light green	None	0.210	0.347	Trace	0.5023	0.0008	0.0006	None	None	21.200	10.350	4.30	36.80	41.10	Good	19
do No. 2	Cloudy, green	do	10.870	17.900	None	0.0898	0.0060	0.0078	0.0264	0.1020	52.470	15.840	16.50	110.00	126.50	Unsatisfactory	20
do No. 3	Turbid, red brown	Rotten wood	11.050	18.210	Heavy trace	1.2260	0.0514	0.0820	0.4830	1.5920	49.500	15.840	32.20	129.00	161.20	Bad	21
W. Ha'pton No. 1	Clear, light blue	None	1.298	2.139	None	0.1610	0.0045	0.0050	0.0200	0.1090	2.079	2.079	1.20	6.39	7.50	Fair	25
do No. 2	do do	do	2.297	3.786	do	0.3120	0 0015	0.0080	0.0160	0.1090	4.950	4.455	6.70	14.00	20.70	Good	26
do No. 3	Turbid, green	do	......	......	Trace	0.6588	None	0.0142	0.0246	0.1182	11.210	10.630	4.50	44.60	49.10	Unsatisfactory	32
Schag'coke No. 1	Turbid, yellow	do	28.230	46.530	Heavy trace	0.6210	0.0105	0.0395	0.0440	0.2110	50.000	32.670	8.00	138.50	146.50	Bad	27
do No. 2	Slightly turbid, light blue	do	7.628	12.570	do	1.257	0.0135	0.0035	0.0210	0.0900	35.146	23.26	12.00	118.30	130.20	Doubtful	28
Lockport No. 1	Turbid, yellow	Fishy	0.807	1.329	Slight trace	None	0.1280	0.0340	0.0610	0.1140	13 464	6.860	2.00	15.70	17.70	Bad	29
do No. 2	Faintly turbid, light blue	None	8.943	14.740	None	1.375	0.0008	0.0067	0.0077	0.0596	40.788	23.190	6.50	90.30	96.80	Doubtful	30
do No. 3	Faintly turbid, yellowish	Faint	1.683	2.774	do	None	0.0054	0.0051	0.0533	0.0832	23,760	10.630	0.90	34.90	35.80	Unsatisfactory	31
Cort. Vil. No. 1	Clear, light blue	None	0.210	0.347	do	0.1235	None	0.0005	None	0.0090	13.530	4.831	2.80	19.60	22.40	Good	33
do No. 2	Opaque, yellowish green	Marshy	0.421	0.690	do	0.2536	0.0120	0.0200	0.0979	0.2516	12.560	3.000	5.00	21.70	26.70	Bad	34
Cazenovia No. 1	do do	do	3.186	5.251	do	0.6560	0.0030	0.0095	0.0718	0.2587	25.350	14.680	9.70	55.5	65.20	Bad	36
do No. 2	Opaque	do	0.370	0.775	do	0.4560	0.0004	0.0042	None	0.0170	18.550	7.700	3.30	39.2	42.50	Unsatisfactory	35
Hamilton No. 1	Clear, light blue	None	1.660	2.740	do	0.987	0.0014	0.0026	Trace	Trace	28.210	10.720	4.00	50.00	54.00	Unsatisfactory, location bad	37
do No. 2	do do	do	0.566	0.930	do	0.329	None	0.0020	do	0.0180	20.680	5.800	2.20	36.20	38.40	Fair	38
Croton Falls No. 1	Clear, yellowish	Suffocating	0.602	0.992	do	0.145	0.0040	0.0050	0.0210	0.0210	4.640	3.090	Trace	10.50	10.50	Good	39
do No. 2	Clear, bluish	None	0.885	1.460	do	0.264	0.0010	0.0030	None	None	3.140	2.660	do	6.80	6.80	Good	40
do No. 3	do do	do	0.850	1.400	do	0.411	0.0004	None	do	do	[illegible]190	2.990	2.80	10.40	13.20	Good	41

ANALYSIS OF WATER.

Results given in Grains per U. S. gallon of 231 cubic inches.

Sample marked.	Appearance. Color.	Odor when heated to 100° Fahr.	Chlorine in chlorides.	Equivalent to sodium chloride.	Phosphoric acid in phosphates.	Nitrogen in nitrates and nitrites.	Free ammonia.	Albuminoid ammonia.	Oxygen absorbed at 80° Fahr. In two minutes.	Oxygen absorbed at 80° Fahr. In three hours.	Hardness equivalent to carbonate of lime. Before boiling.	Hardness equivalent to carbonate of lime. After boiling.	Organic and volatile matter.	Mineral matter.	Total solids dried at 230° Fahr.	Conclusions.
Rome No. 1	Clear, light bluish green	Slight	0.511	0.843	None	0.1470	0.0002	None	None	0.0031	11.214	2.166	0.875	13.355	14.230	Good.
do No. 2	do do	do	1.309	2.158	Slight trace	0.3360	0.0001	0.0002	do	0.0010	11.471	4.588	Trace	21.344	21.344	Fair.
do No. 3	do do	None	0.777	1.281	do	0.1970	None	0.0004	0.0001	0.0010	8.164	2.294	0.991	14.755	15.746	Good.
do No. 4	Slightly turbid, yellowish	Earthy	0.082	0 135	Trace	0.0160	0.0060	0.0043	0.0373	0.1436	4.199	3.313	0.350	4.782	5.132	Not completely satisfactory.
do No. 5	Yellowish green	Faint	3.150	6.191	do	0.0210	0.0002	0.0070	0.0163	0.1189	24.091	3.569	2.216	41.405	43.621	Unsatisfactory.
Watertown No. 1	Turbid, brownish	Earthy	0.061	0.101	do	0.0080	0.0014	0.0038	0.0570	0.2258	3.441	3.186	0.583	3.791	4.374	Unsatisfactory.
do No. 2	Turbid, yellowish brown	do	0.031	0.061	do	0.0140	0.0008	0.0047	0.0532	0.2189	3.951	3.059	0.525	3.615	4.140	Unsatisfactory.
do No. 3	Clear, light bluish green	Slight	5.420	8.933	None	0.0060	0.0012	0.0029	None	0.0149	7.774	1.784	Trace	21.578	21.578	Good.
West Troy No. 1.	Turbid, brownish yellow	Of stable	0.205	0.337	He'vy trace	0.0186	0 0066	0.0715	0.0560	0.1567	4.683	2.263	1.283	8.631	9.914	Bad.
do No. 2.	Turbid, yellow	do	0.184	0.203	do	0.0165	0.0114	0.0395	0.0472	0.1698	4.047	2.041	0.292	8.806	9.098	Bad.
do No. 3.	Turbid, brown	do	0.205	0.337	do	0.0031	0.0696	0.0147	0.0414	0.1516	5.098	2.327	0.233	8.389	9.622	Bad.
do No. 4.	Slightly turbid, yellowish	Earthy	0.205	0.337	do	0.0643	0.0014	0.0044	0.0411	0.1220	5.098	2.485	Trace	9.331	9.331	Unsatisfactory.
South'pt'n No. 5	Clear, light blue	do	2.455	4.047	do	0.4409	0.0041	0.0082	0.0157	0.0791	9.121	4.175	2.799	20.995	23.794	Doubtful.
do No. 7	light green	None	2.863	4.719	do	0.0673	0.0028	0.0065	0.0140	0.0801	3.406	2.231	1.633	9.856	11.489	Doubtful.
do No. 9	Clear light blue	do	2.352	3.870	Trace	0.3621	0.0035	0.0104	0.0157	0.0718	5.715	5.132	2.916	23.327	26.243	Bad.
do No. 10	do do	do	0.920	1.516	None	0.1535	0.0001	0.0013	None	0.0005	1.212	1.155	1.225	4.257	5.842	Good.
do "Lee."	do do	do	1.524	2.528	do	0.0249	None	0.0017	do	0.0009	0.866	0.708	1.575	3.324	4.899	Good.
do No. 4	do do	do	2.454	4.047	do	0.1440	do	0.0061	0.0006	0.0096	7.621	1.501	Trace	17.787	17.787	Bad.
do X	Turbid, yellowish green	do	36.408	60.003	Trace	None	0.1620	0.0018	0.0279	0.0775	16.166	13.856	11.372	79.721	91.093	Bad.
do XX	do do	do	2.557	4.213	Faint trace	0.7100	0.2120	0.0054	0.0220	0.0556	3.349	3.349	5.832	14.579	20.411	Bad.
do XXX	do do	Slight	2.454	4.045	None	0.4092	0.0163	0.0143	0.0210	0.1038	6 420	4.272	9.331	22.623	31.954	Good.
Batavia No. 1	Clear, light green.	None	0.123	0.202	Trace	0.2930	0.0005	0.0004	None	None	12.363	6.036	2.507	21.462	23.969	Good.
do No. 2	Cloudy, green	do	6.339	10.450	None	0.0523	0.0035	0.0046	0.0154	0.0595	30.600	9.237	9.622	64.150	73.772	Unsatisfactory.
do No. 3	Very turbid, reddish brown.	Rotten wood	6.444	10.620	He'vy trace	0.7150	0.0300	0.0478	0.2820	0.9284	28.867	9.237	18.778	75.230	94.008	Bad.
W. Hampt. No. 1.	Clear, light blue	None	0.757	1.247	None	0.0940	0.0026	0.0029	0.0110	0.0630	1.212	1.212	0.700	3.674	4.374	Fair.
do No. 2.	do do	do	1.340	2.208	do	0.1820	0.0009	0.0047	0.0090	0.0630	2.887	2.598	3.907	8.165	12.072	Good.
do No. 3.	Turbid, green	do	......	......	Trace	0.3842	None	0.0083	0.0143	0.0689	6.537	6.199	2.624	26.010	28.634	Unsatisfactory.
Schagh'coke No. 1	do yellow	do	16.463	27.135	He'vy trace	0.3620	0.0061	0.0230	0.0260	0.1230	29.159	19.052	4.665	80.771	85.435	Bad.
do No. 2	Slightly turbid, light blue.	do	4.448	7.330	do	0.7330	0.0079	0.0020	0.0130	0.0520	20.493	13.565	6.998	69.000	75.998	Doubtful.
Lockport No. 1	Turbid, yellow	Fishy	0.470	0.775	Slight trace	None	0.0746	0.0198	0.0356	0.0665	7.850	4.001	1.166	9.156	10.322	Bad.
do No. 2	Faintly turbid, light blue.	None	5.215	8.597	None	0.8013	0.0005	0.0039	0.0045	0.0348	23.788	13.524	3.791	52.651	56.442	Doubtful.
do No. 3	do yellowish	Faint.	0.982	1.618	do	None	0.0032	0.0030	0.0311	0.0485	13.856	6.199	0.525	20.353	20.878	Unsatisfactory.
Cortland Vil. No. 1	Clear, light blue	None	0.123	0.202	do	0.0720	None	0.0029	None	0.0050	7.890	2.817	1.633	11.430	13.063	Good.
do No. 2	Opaque, yellowish green	Swampy	0.250	0.404	do	0.1479	0.0070	0.0117	0.0571	0.1459	7.325	1.749	2.916	12.665	15.571	Bad.
Casenovia No. 1	do do	Marshy	1.858	3.062	do	0.3825	0.0018	0.0055	0.0419	0.1510	14.784	8.561	5.657	32.366	38.023	Bad.
do No. 2	do	do	0.216	0.452	do	0.2660	0.0002	0.0025	None	0.0099	10.818	4.490	1.924	22.861	24.785	Unsatisfactory.
Hamilton No. 1	Clear, light bluish	None	0.968	1.598	do	0.5760	0.0008	0.0015	Trace	Trace	16.451	6.252	2.332	29.160	31.492	Unsatisfactory; location bad.
do No. 2	do do	do	0.330	0.542	do	0.1920	None	0 0012	do	0.0105	12.060	3.380	1.283	21.111	22.394	Fair.
Croton Falls No. 1	do yellowish	Suffocating	0.351	0.578	do	0.0850	0.0023	0.0029	0.0121	0.0121	2.706	1.803	Trace	6.122	6.122	Good.
do No. 2	do bluish	None	0.516	0.851	do	0.1540	0.0006	0.0017	None	None	1.831	1.551	do	3.966	3.966	Good.
do No. 3	do do	do	0.496	0.816	do	0.2400	0.0002	None	do	do	1.860	1.747	1.633	6.065	7.698	Good.

Methods of Analysis.

Total Solids.

The earliest methods of gaining some information regarding a sample of water consisted in evaporating a measured quantity to dryness to determine the proportion of substances, both mineral and organic, contained in the water. The test is still used, as affording an information of a kind not to be disregarded in investigating the quality of a water. In his book on Water Analysis, Wanklyn (Water Analysis, 4th London ed, 1876, p. 3,) says: "In addition to being injurious by reason of organic impurity, water may also be injurious on account of its mineral constituents. These latter may be too excessive in amount, as in the notorious instance of sea-water, or they may be poisonous in themselves. An examination of potable water should therefore include a determination of the amount of organic solids in the water, as well as a testing for poisonous metals."

In these investigations, mineral waters having a medicinal value, are of course not considered.

Wanklyn (loc. cit. p. 14,) also states: "If the solid residue do not exceed 30 or 40 grains per gallon, the amount of solids affords no reason for rejecting the water for domestic use." (This amount would signify about 25 to 30 grains per U. S. gallon, or 43 to 57 parts per hundred thousand.)

It has been found that the figure thus obtained does not, however, represent truly the sum of the organic and mineral matters in all, or even a large proportion of cases. (Tidy Jour. Lond. Chem. Soc., XXXV, 47, Sixth Report Rivers Pollution Commission, London, 1874, p. 4, etc.) Experiments have shown that one gramme of urea with varying quantities of water, evaporated to dryness, yielded amounts varying from 0.98 gm. to 0.007 gm. (Wanklyn, Jour. Lond. Chem. Soc. XX, 445.) Similar results were obtained by Frankland. (Jour. Lond. Chem. Soc. XXI, 79.)

Besides the possible loss of an indefinite quantity of the organic substance in a water, some of the constituents may retain water (as sulphate of lime) most obstinately, at the temperature at which the water residue is dried and weighed, which would cause an error in the opposite direction. Indeed it would be difficult to specify all the possible phenomena which might occur, and on which the belief is based that the determination of total solids is only an approximation.

Organic and Volatile Matter (Loss on Ignition).

Though the mineral matter in a water has a certain importance in judging of a water, the organic matter has a far greater importance, since in it, whether as organized germs or as chemical compounds, are the principles, which, even in very small quantity, make the difference between the safety or danger in using a water. "The really injurious matters are probably organized." (Sixth Report Rivers Pollution Commission, "Blue Book" p. 4.)

The organic soluble matters are more dangerous than the insoluble. It is impossible to specify what these substances are, but they are sub-

stances in a state of change. (Assainissement de la Seine, etc., Government Report, Paris, 1876, I, p. 16.)

Organic and Volatile Matter.

It was naturally supposed that a fair idea of the proportion of organic matter in the water might be obtained by burning out the organic matter from the water residue, and weighing the remainder. As waters ordinarily contain some earthy carbonates which would be rendered caustic by the ignition, it was customary to add a few drops of carbonic acid water or ammonium carbonate, after ignition, and then to dry and weigh the residue, and calculate the loss as organic matter.

Inasmuch, however, as some of the salts contained in a water may be decomposed by this treatment, or entirely volatilized, the modified expression "Organic and Volatile Matter," or "Loss on Ignition" was adopted. Frankland's and Armstrong's experiments on this subject (Jour. Lond. Chem., Soc. XXI, 80) are very instructive. The question is well summarized by Tidy thus (Jour. Lond. Chem., Soc. XXXV, 46): The ignition process supposes,

1. That no organic matter is lost and none gained by evaporation.
2. That all the organic matter is burned off by ignition.
3. That nothing but organic matter is lost by ignition.

In all of these three points the process fails. The results are at best only coarsely approximate. (Vide. Watts Dict., V. 1023). Wauklyn (Water Analysis, 4th Lond. ed., p. 21,) states, "Chemists have been agreed for some years in rejecting the ignition process in the estimation of the organic matter in drinking water." Frankland (Water Analysis, London, 1880, p. 14,) recommends ignition as a rough qualitative test for the presence of organic matter, the degree of blackening taking place, giving some idea of the probable amounts of organic matter present. The test has been made on the samples under consideration, not because it has any great importance, but partly because it has not been entirely abandoned in this country, and partly because the difference between the "total solids" and the "loss on ignition" affords a fair approximation, to the amount of mineral matters present in the sample.

Oxygen Absorbed (*Permanganate test*).

From what precedes, it is evident that some other process for the examination of a water is necessary, in order to decide upon its probable safety for domestic uses. Potassium permanganate is known to be one of those substances which will readily yield up its oxygen, especially in presence of a strong mineral acid as sulphuric, and the idea was long since conceived that this salt could be used to burn up (chemically speaking) the organic matter in a water, and that the measure of the amount of permanganate used could be relied upon as the means of measuring the amount of organic matter in a water.

The process proposed by Forchammer, of Copenhagen, 1850 (Water Analysis, Frankland, London, 1880, p. 52), appears to have been the first in which this reagent was used. This mode of testing water, however, became more general after the publication of a paper on the subject, by W. A. Miller (J. Lond. Chem., Soc. XVIII, 117), though many others, as Condy, Woods, Letheby, R. Angus Smith, etc., contributed to our knowledge of the best modes of making the test, and the conclusions to be drawn from the results.

As ordinarily performed, a measured quantity of the water was acidified with sulphuric acid, and then the permanganate solution added lit-

tle by little, as fast as it was decolorized, the process being continued for one, two, or three hours — always for the same length of time in every case, the solution being kept on a laboratory table loosely covered. Then the amount of permanganate destroyed, or in other words the amount of oxygen taken from the permanganate was taken as the measure of the organic substances present. Frankland (Chem. News, March, 1860), asserted that the most pernicious organic matters are those most easily oxidized by potassium permanganate, and Angus Smith (Chem. News, Sept., 1869, p. 112), pronounced the test a good one for this purpose. The first named gentleman has, however, modified his views since making that statement. (Chem. News, XXXIX, 1879, p. 70.)

Performed as above described, the test did not give results strictly comparable, since the possibility of the introduction of atmospheric dust, the possibility of the conditions as to temperature (which has a marked influence), etc., made some difference with the results.

A modification of Forchammer's process has been proposed by Dr. Tidy, which gives results more satisfactory for comparison, which consists in working with measured quantities of the water, acidified with the same amount of acid, with the addition of an excess of permanganate, while a flask containing the same amount of distilled water is treated in the same way for comparison. At the end of certain periods, two minutes, one hour, three hours, four hours, the amount of permanganate remaining undestroyed is determined. (J. London Chem. Soc. XXXV, 67.)

Dr. Tidy, in his original paper, does not specify that the flasks should be kept at any particular temperature, but attention to that point appears desirable, and that element has been introduced into the process by members of the British Society of Public Analysts (Vid. Analyst for 1881), uniformity on that point appearing to be very desirable.

The results given in the tables under the head of "Oxygen Absorbed at 80° Fahrenheit," were obtained by this method substantially as described, the flasks containing the water experimented upon having been kept standing, during the periods specified, in a water bath, the temperature of which was maintained at 80° Fahrenheit.

The two minute test indicates the probable presence or absence of organic matter rapidly oxidized by the permanganate, and therefore presumably dangerous, or else the presence of nitrites, which in a drinkng water is also regarded as indicating the presence of dangerous pollution.

Frankland's experiments (J. Lond. Chem. Soc., XXI, p. 83,) show that all organic substances are not equally affected by the permanganate, and he therefore does not place much reliance on the conclusions drawn from the use of this test, though a certain correspondence seems to exist between the results of this test and the results of his combustion process, when applied to waters of the same class, thus :

For London water,	oxygen	absorbed	by	about	2.38	organic	carbon
For deep wells	"	"	"	"	5.8	"	"
For shallow wells,	"	"	"	"	2.28	"	"
For u'land s'face w't'r"	"	"	"	"	1.8	"	"

(Water Analysis, Frankland, London, 1880, pp. 55 and 56.)

In many cases, however, no such correspondance could be detected

(Chem. News, XXXIX, p. 70), though a fair correspondence of the kind had been observed in 1418 cases out of 1686.

Wanklyn (Water Analysis, fourth ed., London 1876, p. 22), states that "the defects of the permanganate process are its want of delicacy, and also the circumstance that albumen is not readily attacked by the standard solution of permanganate."

It must be remembered that both of these gentlemen are originators of methods for the determination of probable pollution of potable waters, and each naturally enough has a strong bias in favor of his own particular process, with which he compares any process that may be or has been proposed. Other chemists not affected by such considerations, incline to the belief that the process has considerable value in determining the probable contamination of a water, though they are not disposed generatly to trust it so far as Dr. Tidy is willing to.

A test somewhat similar in its bearing was made use of by the Paris commission, appointed to investigate the question of the purification of the Seine. This consisted in the determination of the volume of oxygen held in solution in a given volume of water. The rapidity with which oxygen is absorbed is considered to be the sign and even the measure of the insalubrity of a water (Assainissement de la Seine, 1876, I, p. 21). The volume of oxygen dissolved in one litre of Seine water at Paris, before receiving the contents of the sewers, was found to be 4.34 cubic centimetres, after receiving sewage amounting to about one-fifteenth of the volume of the river, it was found to be about one-fourth that amount, or 1.02 cubic centimetres, which points to the conclusion that oxygen is absorbed by the oxidation of sewage (loc. cit. p. 20).

The normal amount of oxygen in the water of the Seine is stated by Boudet (Assainissement de la Seine, II, p. 8), to be 9 to 9.5 cubic centimetres per litre. He also adds that waters most charged with organic matter are poorest in oxygen.

Nitrogen compounds in water.

Some time ago, attention was called to the fact that what is dangerous in water is the putrefactive processes which may be going on in it, and that since nitrogenous organic substances are as a rule most liable to putrefactive changes, the deleterious character of a water is no doubt proportional to the amount of nitrogen it contains. (Hofmann and Blyth, Report on Metropolitan Water Supply, London 1856.)

Several methods for the determination of the quality of a water are based upon this idea:

That of Frankland consists in the determination of the amounts of carbon and nitrogen contained in the residue obtained from evaporating a measured quantity of the water with certain precautions. Over 0.2 parts of "organic carbon" (carbon determined by this method), in one hundred thousand, when the carbon comes from vegetable matter alone, is stated to render the water bitter and unpalatable, though the presence of organic matter of animal origin does not have this effect on the taste where the proportion of organic carbon is much higher, though the water is much more unsafe for use. (Sixth Report River Pollution Comm., p. 5). The commission consider that if the organic matter is derived even only partially from animal sources, the amount of organic carbon should not exceed 0.1 part per hundred thousand for the water to be considered safe.

The proportion of carbon to nitrogen in a water is, however, looked upon as an important point in deciding on the safety of a water. From numerous analyses, Dr. Frankland (Water Analysis, London 1880, p. 84) deduces the following proportions of nitrogen to carbon, the amount of nitrogen being taken as unity irrespective of its actual amount.

	Ranges from	Average.
For upland surface waters,	1:4 to 1:21	1:10
" water from cultivated land,	1:4 " 1:10	1:6
" shallow wells,	1:1 " 1:9	1:4
" springs and deep wells,	1:2 " 1:6	1:4
" urine and sewage,	1:1 " 1:3	1:2

Information of value as to the quality of a water is no doubt given by this method of testing, but the process has been severely criticised by advocates of other processes for water analysis, as to the analytical methods used to obtain the results, and hence as to the results themselves. (Wanklyn Water Analysis, 4th London ed., 1876, p. 22; Tidy, Jour. London Chem. Soc. xxxv, 51.) Chemists generally find that the process requires delicate and costly apparatus, and involves troublesome manipulation, with the risk of making unavoidable errors, larger than the entire amounts experimented upon, though the idea of determining the amounts of carbon and nitrogen in the organic matter of a water, and their ratio to one another, if it could be done with fair accuracy is thought to be most excellent.

Ammonia.

It is generally accepted as a fact that the nitrogenous organic matter in water by the process of putrefactive decomposition first affords considerable quantities of ammonia, then of nitrites and finally nitrates. By this it is not meant that these changes succeed one another sharply, but that when water has taken up some organic matters containing nitrogen in the first stages of the decomposition of that organic matter, ammonia is usually most prominent, and later on especially if the water percolates through the soil, nitrites and nitrates assume prominence.

Tronnisdorf (Fres. Zeitschrift for Analyt. Chem. IX, 165), states that ammonia is the product of the putrefaction of nitrogenous organic matter, and nitrates the last product of their decomposition. Boudet (Assainissement de la Seine, 1876, II, p. 5), makes essentially the same statement with regard to the ammonia, and adds "there is reason to believe that there exists a relation of proportions between the quantity of these substances (organic matters), their degree of decomposition, the ill-health which they produce, and the ammonia of which they are the source, and which they leave in solution in waters."

The Rivers Pollution Commission (loc. cit., p. 12), state that ammonia in waters is derived almost exclusively from the decomposition of animal matter. References of the same purport might be given from numerous other high authorities.

Investigations, the results of which are embodied in the report of the Paris Commission (Assainissement de la Seine, I, p. 16), showed that on adding sewage to the Seine the ammonia was increased from 0.06 to 1. or 1.5 milligrammes per litre (0.006 to 0.1 or 0.15 parts per 100,000).

Rain water, however, especially when its falling is accompanied by electrical phenomena, may contain some ammonia. An average of 71

samples of rain water collected in England, contained 0.05 parts ammonia per hundred thousand, including a maximum of 0.21 part, which was exceptional. (Rivers Pollution Commission, 6th Report, 1874, pp. 27 to 29.) Frankland (Water Analysis, London, 1880, p. 18), gives the following averages for ammonia in 100,000 parts of water:

Rain water in the country, 0.03 parts.		
Upland surface-water,	0.002	maximum, 0.008.
River waters,	0.01.	
Spring waters,	none, or very minute amounts.	
Sewage,	5.	varying from 2 to 10 parts.

Fischer (Chemische Technologie des Wassers, Brunswick, 1875, p. 105) gives two analyses of typically good wells, containing respectively 0.048 and 0.044 parts of ammonia per 100,000, and of two typically bad shallow wells, containing respectively 0.084 and 2.227 parts ammonia in the same amount.

The proportion of ammonia, however, though giving valuable information as to the quality of a water, is subject to variations. Houzeau (Comptes Rendus, LXXXIII, 525), showed that water containing ammonia gradually lost that constituent by standing. The probability of the change being caused by an organized ferment was suggested. Other experiments by M. Houzeau, and by others, have proved this hypothesis. (Schloesing and Munz, Comptes Rendus, LXXXIV, 301; Boussingault; Warington, Jour. Lond. Chem. Soc., 1878, I, 74; Storer, Am. Jour. Sci. and Arts, XV, June, 1878), etc., etc.

In the Paris Report Assainissement de la Seine, pp. 152, 159, 187, etc., it is stated that the humus of the soil is an active agent in oxidizing the ammonia and nitrogenous organic matters to nitrates and nitrites.

Notwithstanding such possibility of changes in the amount, the determination of the proportion of ammonia in a water is evidently of too much importance to be neglected.

Free and Albuminoid Ammonia.

In view of the facts already mentioned, and also in consideration of the fact that albumen and similarly constituted nitrogenous substances could be made to give up a definite proportion of their nitrogen in the form of ammonia when boiled with an alkaline solution of potassium permanganate, Wanklyn and some others proposed a method for the determination of the probable safety of a water by boiling it first with some alkaline solution, as sodium carbonate, and then with an alkaline solution of potassium permanganate. The ammonia formed or given off by the first part of the treatment described, is designated as "free," that by the latter part of the treatment as "albuminoid." (Jour. Lond. Chem. Soc., 1867, XX, 445, Wanklyn, Chapman and Smith.) The ammonia being carried over with the stream, is caught in the distillate and there determined. Since impure urea, when boiled with alkaline solution, yields ammonia, some have called the ammonia thus obtained "ureal" ammonia, instead of "free." In fact, as can readily be seen, the amount of ammonia obtained by boiling with sodium carbonate represents the ammonia actually present as such, plus the amount derived from the decomposition of urea or kindred bodies present. Still,

independent of the question of the name, urea, or bodies of similar constitution, should not exist in a water to be used for drinking purposes, and the amounts of ammonia to be obtained in this way adds not a little to our knowledge of the probable quality of a water.

The following results from Wanklyn's book on the subject, Water Analysis, 4th ed., Lond., 1876, indicate that some correspondence exists between the amounts of free and albuminoid ammonia and the degree of contamination.

Deep spring water,	Not over 0.001	part per 100.000
" " "mixed with surface water,	0.005	" " "
Filtered water,	0.005 to 0.010	" " "
Water imperfectly filtered,	0.01 " 0.02	" " "
Sewage (Harrowgate), free 5.50	0.3	" " "
Urine, free 900.	50.	" " "

Water imperfectly filtered—the fourth on this list has been observed to produce diarrhœa in communities using such water (loc. cit., p. 39). Other samples of sewage yielded different results, but the main fact that the proportions of free and albuminoid ammonia are high in sewage, and in numerous waters known to be dangerous, is shown by Wauklyn's experiments.

When the free ammonia is over 0.008 (per 100.000), it is believed by Mr. Wauklyn to be almost invariably derived from the fermentation of urea, and of course the water is to be regarded with suspicion, but the most important point in the estimation of Wanklyn is the proportion of albuminoid ammonia.

This process on account of its ease of execution, and usually (presumably), reliable indications has been much used by chemists both in England and here. It has been severely criticized as usual with any process which might be proposed to take such an important part in a matter of such vital consequence (Vid. Frankland, Jour. London Chem. Soc., XXI, 79, XXIX, 84; Tidy, Jour. London Chem. Soc., XXXV, 61, 96). Others not prejudiced in favor of any particular method of water analysis have found, or believe they have found, cases in which bad waters would not be condemned by this process. Ekin (Potable Water, London 1880, p. 9), says: "Waters which have undoubtedly given rise to typhoid fever, have been found by the writer over and over again not to contain more than 0.05 parts of albuminoid ammonia in one million (0.005 in 100,000—regarded by Wanklyn as safe), and notwithstanding their containing a large excess of nitrates, have been passed by analysts of undoubted ability as being fit for drinking purposes." A case in point is cited. A similar case, where the water was afterward proved to be contaminated with sewage, came to the personal knowledge of the writer of this report.

Some chemists, however, have as implicit faith in this process to the exclusion of every other, as the inventor of it himself, but many others consider it as only to be relied upon to a limited extent, *i. e.*, that the probabilities are against a water which is condemned by this process, but that if it appear to be good by this process it may not really be safe in all cases.

Nitrogen as Nitrates and Nitrites.

As already mentioned there is good reason to believe that the oxidation compounds of nitrogen, nitrates and nitrites, when in water, are derived from the oxidation of nitrogenous organic material chiefly of animal origin. The investigations of Palmer on the nitre deposits of India (Jour. London Chem. Soc., XXI, 318), showed that nitrates (in sufficient quantity to make the collection of the soil and subsequent leaching of it profitable), only occurred around habitations, and places where large amounts of animal matters were deposited. The Rivers Pollution Commission state (6th Report, p. 12), that the presence of nitrates and nitrites indicate previous animal contamination, since vegetable matters furnish none or mere traces,these compounds being formed more rapidly by percolation through the soil than by flow in a stream. This point is sustained by numerous authorities. Frankland gives the following amounts as occurring in waters. (Water Anal. London, 1880, p. 28.)

	Variation.	Average.	
Rain water (71 samples),	0 to 0.044	0.007	parts per 100,000
Upland surface water,	0 to 0.05	0.009	" " "
Deep wells and springs,	0 to 3.	0.40	" " "
Surface waters (cultivated d'trict)	0 to 1.*	0.25	" " "

Shallow wells, no average, 2. to 5. parts common.

Prof. Wagner (Jour. für Gasbeleuchtung, No. 8, 1873), estimate that the amount of nitrates used from the Munich wells in one year calculated as saltpetre, would give 670,000 killogrammes (about twice that number of pounds) of saltpetre, which would suffice to make over 18.000 cwt. of gunpowder.

Of course in themselves these compounds to the extent to which they exist in water are harmless, but are simply the indication of contamination at some time, and there is a great difference of opinion as to the value of the conclusions to be drawn from their presence. Frankland (loc. cit.), believing that a water which has once been contaminated, is always open to suspicion, takes the ground that their presence is of great importance in pronouncing upon the safety of the water, while Wanklyn (Water Analysis, p. 83), considers them of but little importance in measuring the defilement of a water, and argues that since some strata (as the chalk formation), yield large amounts of nitrates to water, and on the other hand processes of vegetation in rivers and lakes are calculated to withdraw nitrogen in those forms from the water, hence the proportion of nitrates "affords no data of any value in judging of the organic quality of a water. All shades of opinion on this point exist between these two extremes, but the general impression is in favor of Frankland's view, since by accepting that the error, if any, is on the side of safety.

Though large amounts of nitrates usually indicate percolation through the soil, which probably may eventually purify the water completely, there is room for questioning whether the oxidation of the dangerous ingredients has been complete. A case is referred to in the Rivers Pollution Commission Report (6th Rept. Appendix No. 4, p. 463), taken from Deutsche Vierteljahrsschrift fur öffentliche Gesundheitspflege,

* Of rare occurence.

vol. vi, p. 154, where typhoid fever poison was not removed from a subterranean stream after passing underground for nearly a mile. This may have been an extraordinary case, but such a condition of affairs might occur elsewhere, and it may be difficult to decide where.

Some chemists regard the presence of nitrites (a lower degree of oxidation than the nitrates) as an indication that the oxidation of the dangerous compounds has probably been incomplete, and accordingly condemn water in which these are found. (Heraeus Archiv der Pharma., Apr., 1873; Tidy, loc. cit. p. 75) but nitrites are of rare occurrence in water, and many waters might be polluted and yet give no indication of the presence of nitrites to any test we might apply.

Chlorine.

In noting so far as possible the distinguishing characteristics of sewage, from the presence of which in water so much danger is to be feared, the large proportion of chlorine in combination as chloride is very noticeable. On this account the presence of chlorides in a drinking water has been accounted as of some importance in the examination of a water. Food contains considerable amounts of chlorides, and we add to it still more by way of condiment in the shape of salt. The well-known fact that animals as well as men require salt more or less frequently with their food, needs but a passing allusion. The chlorine, whatever changes it may pass through, is thrown off from the system in the excreta and thus appears in the sewage.

Frankland gives the following average number of parts per hundred thousand in waters from various sources:—

(Water Analysis p. 19)

Rain water,	0.22
Upland surface water,	1.13
Deep wells,	5.11
Springs,	2.49

The Rivers Pollution Commission give per 100,000 parts, 6th report, pp. 19, 20:

Sewage maximum, 21.5. Minimum, 6.5. Average, 11.54.

The effluent waters from various manufacturing industries showed amounts varying from 19.750 parts (from a bleachery) to 0.6 part as a minimum.

Over 5 parts per 100,000 is considered by the commission as in most cases due to pollution.

Various considerations, however, such as the nature of the strata through which the water passes, proximity to the sea, etc., affect the proportion of chlorine which may be present in a water, and the test is chiefly of value where the normal amount which the water should contain is known, and if it exceeds that, a further investigation is desirable. (Fischer, Chemische Technologie des Wassers, Brunswick 1880, p. 105; Wanklyn, Water Analysis, 1876, pp. 15 and 16.)

Vegetable contamination, however, should be avoided, and against this the determination of the chlorine is no guarantee. (Wanklyn, loc. cit., also p 41.) The difference in the amounts of chlorine present in a water free from sewage, and the same water containing a small, but perhaps dangerous amount, are sometimes too small to attract notice.

The test, therefore, though of some value, has not all the importance which has often been ascribed to it.

In the tables of results the proportion of chlorine has been given, and in the next column the sodium chloride, corresponding to it, as giving a better idea of the amounts present.

Hardness.

Lime salts are the chief cause of hardness in water; compounds of magnesia, iron, and other elements, however, also may contribute to the soap-destroying power of the water, which is practically meant by the term. Chemists recognize two kinds of hardness: 1. Temporary, which is caused by the presence in the water of those elements held in solution in consequence of the presence of carbonic acid. By boiling the water, the carbonic acid holding them in solution is driven out, and the compounds in solution, in consequence of its presence, separate in the solid form, and can be removed by filtration. 2. "Permanent" hardness, which is caused by the above bases, which are in combinations not converted into the insoluble form by boiling sulphates, chlorides, etc., chiefly the first named The temporary and permanent hardness together constitute the "total hardness."

To express the hardness in some tangible form, the usual custom in this country and in England is to give results in the corresponding amounts of carbonate of lime, *i. e.*, practically to determine the amount of soap destroyed by a measured quantity of the water, and then to state the results as the amount of carbonate of lime which would destroy that quantity of soap.

The Rivers Pollution Commission gives the following figures for the hardness of waters in parts per hundred thousand:—

	Temporary.	Permanent.	Total.
Rain water, average,	0.3	1.7	0.62
Highest from different geological formations,	38.6	48.5	75.
From 272 samples of water from shallow and polluted wells:			
Minimum	0.	3.8	9.9
Maximum,	52.	164.3	191
Average,	19.	31.5	50.5

On account of the presence of considerable amounts of lime compounds in our food, sewage is usually quite hard, especially exhibiting a high figure for permanent hardness. Like the chlorine, the test has some bearing on the question as to whether the water is probably polluted with sewage or not, but is of far inferior importance, since, as the above figures show, the proportions of constituents making the water hard may run very high in a water uncontaminated by sewage.

The hardness has, however, much significance, upon the economic side. Hard water is objectionable for domestic purposes, in washing, and for manufacturing purposes in boilers. With regard to its effect upon health, the English Commission took a great deal of testimony. (6th Report, pp. 184 to 194). One witness said that soft water was more conducive to health, as people were more apt to be cleanly when they had soft water to use; another that lime-sulphate in the water appeared to disagree with some persons; another that the death-rate was appa-

rently a little lower in towns supplied with moderately hard water. About 10 to 14 degrees of hardness per gallon (14 to 20 per hundred thousand), was deemed by some to be beneficial. The question of the connection of the hardness of the water with the death-rate was investigated, and from numerous statistics taken in the United Kingdom, it was found that there seemed to be no necessary connection. The conclusion of the commission was, that though there were some differences of opinion "there is almost absolute unanimity as regards the wholesomeness of soft water." Popular prejudice runs in the same direction, especially when comfort in washing, and economy of soap and boilers are taken into consideration, while for sanitary purposes no objection can be urged to the use of soft water, other things being equal.

In our tables of results the hardness is stated as mentioned in the equivalent of carbonate of lime. The hardness "before boiling" is in effect "total hardness," that "after boiling" the "permanent hardness," which latter is the most objectionable form. It might be taken as an approximate statement of the relative amounts of sulphates present in the waters. The difference between the two forms of hardness would give the temporary hardness, the measure of the amounts of carbonates present.

Phosphoric Acid in Phosphates.

Sewage undoubtedly contains a considerable amount of phosphates, the presence of lime, however (if, as is usually the case, the water contains alkaline or earthy carbonates), tends to precipitate the phosphoric acid out of the water, and, except in very small amounts, phosphates cannot exist in a clear water. Their presence, however, in a water would indicate a possibility of sewage contamination, though in some cases they might be derived from geological formations. The test was therefore made qualitatively, to obtain, if possible, more light on the probable safety of the water examined.

Odor.

For comfort, if for nothing else, potable water should be free from odor. The odor often may give rise to suspicions which a subsequent examination may confirm. At times, however, waters have unpleasant odors and taste which do not seem to have any effect on their safety for domestic uses. These seem to be connected with the appearance or death in the water of some of the microscopic organisms invariably present in water. The odor, therefore, alone, may be misleading, but may serve as an adjunct to a more extended examination.

In making the test recorded, about three or four ounces of the water was placed in a small flask fitted with a cork, through which was passed a thermometer. After introducing the water and inserting the cork, the flask was warmed until the thermometer indicated 100° F. The flask was then shaken, the cork withdrawn, and the odor immediately observed. In this way satisfactory and uniform tests were obtained.

Appearance, Color.

The appearance, like the odor, of a water, may at times be objectionable, a turbidity, however, after standing some time, indicates mat-

ter in a minute state of sub-division, which is, to say the least, undesirable, even though it may be innocuous.

As to color, the natural color of a pure water is light-bluish, but impurities may modify that tint very much. Tidy recommends (Jour. Lond. Chem. Soc., xxxv, 84), making an observation on the color of waters examined in conjunction with other tests. He believes that to a practiced eye

"1. The peculiar *tint* is an indication of the *kind* of organic matter present.

2. The tint-depth is the indication of the *quantity* of organic matter in a water."

Fresh peat imparts a peculiar greenish-brown tint, older peat an olive-brown tint. A yellow tint is often a suspicious sign, while a faint bluish-tint is that of water probably very pure.

Dr. Frankland characterizes this view of the subject as purely sentimental. (Chem. News, xxxix, p. 69). Dr. Angus Smith (Chem. News, June, 1869), asserts that a colorless water may be bad, and a colored water may be good.

The results recorded on these points were obtained by the use of what is known as the "two-foot tube," a colored glass tube two feet long and about two inches in diameter, closed at either end with a glass plate cemented on, and filled with the water to be examined. By sighting through the tube toward a piece of white paper held at the opposite end, the appearance noted was observed.

Standards.

Some analysts have fixed certain standards of purity for water, or limits for the results of certain of the above mentioned tests, according to which, if certain figures are exceeded, the water is to be condemned as unsafe. These proportions, though stated in different ways, grains per gallon, milligrammes per litre, etc., are here all given in parts per hundred thousand, for uniformity.

Frankland (Water Analysis, London, 1880, p. 86) gives the following for the amounts of nitrogen and carbon together:

Class.	Upland surface waters.	Other waters.
I, great purity.	0. to 0.2 parts.	0. to 0.1 parts.
II, medium.	0.2 to 0.4 "	0.1 to 0.2 "
III, doubtful.	0.4 to 0.6 "	0.2 to 0.4 "
IV, impure.	over 0.6 "	over 0.4 "

For spring and deep well-water the proportion of nitrogen to carbon is of but little importance, though the amount of carbon should not much exceed 0.1 part of carbon.

In surface water, if the proportion of nitrogen to carbon is 1 to 3, the organic matter is of animal origin, if 1 to 8 it is chiefly of vegetable origin (p. 83).

If the chlorine exceeds 5 parts, sewage is to be suspected, if under 1 part, the water is probably free from sewage (p. 20).

The Rivers Pollution Commission, of which Dr. Frankland was the chemist, establish a standard based on the probable previous sewage contamination of a water. After deducting for the nitrogen, which might come from the rain, etc., 0.032 part of nitrogen, and assuming that sew-

age contains 10 parts of nitrogen per 100,000, this formula is used. Previous pollution = 10,000 (N–0.032), in which N represents the amount of nitrogen found by analysis in 100,000 parts of the water. The standards then given are:—

Reasonably safe.	Previous contamination	not over 10,000 parts.
Suspicious	" "	" " 20,000 "
Dangerous	" "	—over 20,000 "

(6th Report, p. 17.)

Dr. Tidy classifies waters according to the amounts of oxygen which they absorb from potassium-permanganate in an acidified solution, as before mentioned, after standing for three hours (Jour. London Chem. Soc.. xxxv, p. 91). His standards are:—

Class 1.	Great organic purity,	absorb	0 to 0.05	part oxygen.
" 2.	Medium purity,	"	0.05 " 0.15	" "
" 3.	Doubtful,	"	0.15 " 0.21	" "
" 4.	Impure,	"	—over 0.21	" "

The absorption of considerable amounts of oxygen in two minutes indicates the probable presence of nitrites, which should not be present in a water.

Prof. Wanklyn bases his judgment of a water on the indications of the amounts of free and albuminoid ammonia (Water Analysis, 4th London ed., 1876, pp. 53 and 54). His classification referred as above to parts per hundred thousand:—

Class 1.	Extraordinary purity,	0 to 0.005	part albuminoid ammonia
" 2.	Satisfactory purity,	0.005 " 0.010	" " "
" 3.	Dirty,	—over 0.010	" " "

If the albuminoid ammonia exceeds 0.005 parts, the free ammonia must be taken into account. Much free ammonia is a suspicious sign of probable recent sewage. If free ammonia is absent or small in amount, a water should not be condemned unless the albuminoid ammonia is something like 0.010 part albuminoid ammonia; while over 0.015 part ought to condemn a water absolutely.

The absence of chlorine, or a small proportion with large amounts albuminoid ammonia, would indicate probable vegetable contamination. A large proportion of chlorine, 7 to 14 parts, may be under some circumstances suspicious. Over 57 parts of total solids must be regarded as objectionable.

Mr. Ekin, F. C. S., who has had much experience in the examination of suspected sources of water supply, in a critique on the various methods of water analysis, and the conclusions to be drawn from them, accepts, with some qualification, some of the standards given, but insists as the result of experience that the proportion of nitrogen as nitrates should be taken into account, as of primary importance. (Potable Water, London, 1880, p. 20.) If the amount exceeds 0.5 or 0.6 parts, he believes the water is dangerously polluted.

Other authorities support this view, fixing the limit, however, at other points (Fischer Chemische Technologie des Wassers, p. 140), thus:—

The Vienna Commission, at the equivalent of	0.104	parts per 100,000
The Hanover " " " " "	0.26	" " "
Brandes at the equivalent of	0.7	" " "

Fischer (Jour. für Prakt. Chem. [2] VIII, 123), considers that at most a good water should contain per 100,000;—

1. Organic matter, 4. parts equivalent to 0.2 part absorbed oxygen.

2. Chlorine, 3.55 to 4. parts.
3. Nitric acid (N_2O_5.), 2.7 parts equivalent to 0.7 part nitrogen.
4. Sulphuric acid (SO_3.), 8 parts.
5. Magnesia (MgO.), 2.4 "
6. Lime (CaO.), 8.0 "
7. Hardness equivalent to Lime 16.8° German standard. Equivalent to about 29. parts carbonate of lime.

Ammonia and nitrites should not be detected by test made on the water without concentration.

The English authorities practically agree in saying that so much as is possible to be learned regarding the history of a water, is to be taken into account in giving an opinion upon it.

The English Society of Public Analysts, while not accepting the rigid interpretation put upon the various determinations recommended by inventors of different processes, consider that they all have some value in forming a judgment regarding a water, and a system of valuation has been proposed in that society, which takes all the determinations made as recorded in the accompanying tables (except organic and volatile matter) into account, by which a water is to be judged. Of course different degrees of importance represented by numbers, are attributed to the different determinations, and from the sum of all these numbers a decision is pronounced. (Analyst, 1881, vol. VI, 111.) The plan, though perhaps capable of improvement in some of its details, is regarded as good.

The decisions on the waters under consideration in accordance with the above standards, though agreeing in the main, are sometimes widely at variance. In one of the tables, the decisions according to these different standards are given in illustration of this point.

Conclusion.

In reviewing the methods of water analysis for sanitary purposes, and the conclusions to be drawn from the results, we cannot but conclude that our knowledge of the whole matter falls very far short of what is desirable.

The nature of the body or bodies which renders a water dangerous to health, is as yet unknown. That they contain organic elements, carbon, nitrogen, hydrogen and oxygen, is very probable, since the waters which harm human beings by their use, unless contaminated by mineral poisons, are those containing perceptible amounts of those elements. That they are organized bodies, germs if we will, is also probable, yet both of these hypotheses are after all only hypotheses, though based on a large array of facts.

We may, perhaps, hope at some future day to discover by chemical means the constitution of certain organic compounds produced by, or forming an integral part of these bodies, and be able to separate and determine them, or, by the aid of the microscope, to find and identify the germs which are objectionable. This, however, is speculation as to the future. At the present time, the utmost that we can do is to

endeavor to discover whether a given water affords favorable conditions for the growth of dangerous germs, assuming that hypothesis to be correct. The processes of putrefaction, especially those of animal matters, are most likely to afford organisms dangerous to the human system; therefore, though some dangers are to be apprehended from decaying vegetable matter, the dangers from the presence of sewage in a water are much greater. If, then, we could detect even the minutest traces of sewage in a water, it would serve as a basis for pronouncing a decision upon it. But here again we are at fault, since, so far as known, there is no element or principle existing in sewage and characteristic of it which would survive the percolation through a few feet of soil, that does not exist in waters of undoubted purity. Organisms which can be recognized and classified, carbon and nitrogen, ammonia, nitrates, chlorine, lime salts (represented by hardness), etc., all are found in waters the safety of which for use is beyond question. We are driven to determining, as near as possible, the amounts of some of those substances which may exist in pure waters, and then regarding any results in a suspected water which show larger amounts of those substances than the water properly should contain as suspicious signs. That is what all of the various tests proposed by numerous chemists can claim to do.

But again, how much of these different constituents should the water properly contain? A review of the different amounts of carbon, nitrogen, ammonia, etc., that pure waters may contain, as given by the best authorities, shows such wide differences in pure water, from different sources, that the attempt to draw a line anywhere seems hopeless. But one circumstance comes to our aid, but that does not go very far. The water from mountain springs contains these compounds, varying between certain limits, that from undefiled rivers between certain other limits, and so on for water from other pure sources of supply. Then, by drawing a line for each constituent at the maximum amount of these constituents found to exist in waters known to be pure, and condemning all waters which come from sources under similar conditions which contain more than those amounts, we can fix *some* limit, though those are far from satisfactory.

By this means we may condemn many good waters as bad, and what is worse, pass many bad waters as good. Suppose, for instance, that pure water in a mountain region contain 0. to 0.5 part of nitrogen as nitrates, and 1 to 2 parts of chlorine per hundred thousand.

Now suppose in such a certain water, which normally contains 0.02 parts of nitrogen as nitrates and 1. part of chlorine, to receive a small addition of sewage sufficient to bring the figures respectively up to 0.04 and 1.5. Now, unless the water had been analyzed immediately before the addition of the sewage, and again after, there would be no good reason for condemning it, and yet it may have been completely poisoned. Even if it had been analyzed some little time before, we would be uncertain about condemning it, as it is well known that the water from the same spring may be different in composition at different times, owing to rains, and also to other causes, the reason for which is not so apparent.

The chlorine and nitrogen, as nitrates, have been taken simply to illustrate the point; any other constituent or determination made on waters by analysis would serve in the same way.

Evidently the means of determining, even approximately, the safety of a water are at present extremely crude and unsatisfactory.

It has been assumed in the above discussion that the methods of analysis employed were absolutely correct and gave absolutely correct results. When, however, we consider that the errors to which all human beings are liable, attaches to chemical manipulations as well as to any thing else, and that the "margin of error" is always an element in chemical work, and also that our process for obtaining results may contain unsuspected sources of error, the unsatisfactory nature of deductions drawn from an examination are increased.

Our present methods are the best we can do, but fall very far short of what is to be desired, and what it is to be hoped we may some day attain.

Respectfully submitted,

ELWYN WALLER, PH. D.

State Board of Health of New York.

REPORT ON THE METHODS AND APPARATUS FOR TESTING INFLAMMABLE OILS.*

ARTHUR H. ELLIOTT, Ph. B.; F. C. S., School of Mines, Columbia College.

I. INTRODUCTION.

Any argument in favor of the State taking upon itself the duty of regulating the quality of kerosene oil appears very superfluous to those acquainted with the nature of the oil now sold, and the damages to life and property due to the unregulated sale of this illuminating material throughout the State.

In New York city it is the province of the "Bureau of Combustibles" to test the oils sold. In the year 1880 the fire commissioners' report shows that there were 103 fires from kerosene oil lamps in a total of 1783 fires from all causes; fifty-four of these fires from kerosene are designated explosions, and from these "explosions" there was a loss by fire of $14,165. These fires occurred in spite of the vigilance of the Bureau of Combustibles in testing the kerosene oil sold in New York city. Of over nine thousand samples collected forty-three were found below the standard test of 100° Fahrenheit in Tagliabue's closed apparatus.

But the loss in a city like New York, with its finely-equipped and ever-ready fire department, is no measure of the damage done in other cities and towns throughout the State, where the oil is never tested, and where the largest amount is consumed, since gas-light is not obtainable or costs much more than in New York city. The fires caused by kerosene oil lamps are rated third in point of number, and the reason there is comparatively so little damage done in a city like New York is more to the credit of the fire department than to the quality of the oil sold to poor and often ignorant people who are compelled to use it as the cheapest source of illumination.

The danger from kerosene oil lies in the fact (often pointed out before) that it is a product of crude petroleum, which consists of a variety of inflammable liquids which the oil refiner should separate from one another in the most careful manner.

* These investigations have been made in accordance with instructions of the State Board of Health to its Sanitary Committee, in terms as follows:
"*Resolved*, That the Sanitary Committee be authorized to spend a sum, not exceeding one hundred and fifty dollars, in prosecuting the investigations preparatory to testing petroleum, in establishing a standard for such test in this State." E. H. *Secretary of the Board.*

These various liquids contained in crude petroleum are more or less volatile, and it so happens that the most volatile give the most brilliant light when burnt. It is also a fact that the vapors of the more volatile portions of crude petroleum mix very readily with air and produce mixtures that explode violently when ignited. The crude petroleum cannot be burned in a lamp without refining because of these easily ignitable vapors and also because of its odor. It then becomes the duty of the oil refiner to distill the crude oil in order to separate the more volatile liquids from those less volatile and select those best suited to burn in an ordinary kerosene lamp. From what has been said above it is obviously to the interest of the oil refiner to leave in the oil called kerosene as much of the more volatile materials as is consistent with his idea of safety, since these add materially to the brilliancy of the light. It must be further noted that it is the kerosene oil that is the most valuable to the oil refiner, since it brings a better price than the more volatile liquids, and the more of these latter he leaves in his kerosene the greater his profits. It has been left to the oil refiner to decide as to the amount of these more volatile liquids he shall leave in his products, in face of the fact that it is to his interest to leave in as much of them as possible. From a consideration of this circumstance alone, it is obvious that much oil sold in New York and elsewhere is only just able to pass when tested under circumstances similar to those that obtain in burning in an ordinary kerosene lamp. And it cannot be doubted that in places under no supervision by inspectors, there is much oil that is dangerous to life and property.

Of the 103 fires in New York city last year (1880) from kerosene oil lamps I have noted that fifty-four were caused by "explosions"; the other forty-nine were caused by the breaking of kerosene oil lamps. If the oil in these lamps had been of the proper quality these fires would not have happened, for it is only low-test oils that take fire at a low temperature. Kerosene oil with a high flashing point will have a high burning point; *i. e.:* Oil that will not give off inflammable vapors at a comparatively high temperature will not take fire itself until it is raised to a still higher temperature. For example, an oil that can be raised to 140 degrees Fahrenheit before it will give off an inflammable vapor can be burnt in a lamp; that lamp broken, and only the ignited wick will still burn. But under the same circumstances an oil which gives off inflammable vapors at 100 degrees Fahrenheit will not only burn at the ignited wick, but flames will run over the whole surface of the oil and envelop every thing that it comes in contact with. If we now remember that in summer our houses often have a temperature of ninety degrees Fahrenheit, and that the best oils sold in New York

city will give off inflammable vapors at but a few degrees above 100, we need not be surprised at kerosene oil explosions, and fires caused by using inferior grades of oil with low flashing points.

The loss of property from these causes is bad enough, but the loss of life, and more often, what is much worse, permanent injury resulting from burning with the low-grade oils, makes this matter pre-eminently a proper one for State regulation. It is not the better informed and intelligent citizen that runs these risks to life and property, because he uses gas or a safe kerosene oil. It is the poor and hard-working people, not so well informed, and whose few dollars have to be made to go the farthest in purchasing the necessities of life that suffer most. These people buy inferior oils because they cost a trifle less than safe ones; the management of the lamps usually falls to the lot of the women and children of the household who least appreciate the danger of handling these low-grade oils. These oils often emit enough vapor in a warm room to burn around the base of the burner in small bluish jets, and a woman or child, under such circumstances, gets frightened, lets the lamp fall, becomes enveloped in flames, and if fortunate, may escape with life and scars to be carried to the grave. This is no fancy picture, even the newspapers contain accounts of these horrors every few days, and they are generally due to the use of low-grade kerosene oils. Any fear in handling a kerosene lamp or danger from breaking one is entirely removed by having the flashing point of the oil so high that no inflammable vapors shall be given off from it at temperatures that may obtain in the burning of an ordinary kerosene lamp. And the number of these accidents from kerosene oil shows that the oil refiners will not raise the standard of quality in refining these oils unless some pressure is brought to bear upon them by the State.

To determine at what temperature a sample of kerosene oil will emit an inflammable vapor, quite a number of pieces of apparatus have been devised. The points that need attention in these apparatus are, gradual heating of the oil, an accurate register of the temperature, and a sharp and uniform means of igniting the vapor when it forms.

Of the various apparatus used for this purpose I have examined the following:

I. Tagliabue's Open Tester.
II. Arnaboldi's Open Tester.
III. Saybolt's Open Tester (Electric).
IV. Tagliabue's Small-closed Tester.
V. Tagliabue's Large-closed Tester.
VI. Wisconsin State Tester (Loosely closed).
VII. English Government Tester (Abel's closed).

VIII. Bernstein's Tester (closed).
IX. Millspaugh's Tester (closed).
X. Mann's Lamp Apparatus.
XI. Foster's Automatic Tester.
XII. Salleron-Urbain Apparatus
XIII. Pease Electric Tester.

The following table shows the results obtained with these apparatus when used on four different samples of oil. The oils marked Nos. 1 and 3 were the best sold in New York city; the oil marked No. 2 was bought at a small store on Second avenue, New York, and had a pale amber color; No. 4 oil was a mixture of No. 2 oil and petroleum naphtha of seventy-one degrees Beaumé, to reduce the flashing point. Each apparatus was tested at least twice and often many more times to insure a fair trial, and the results given in the table are averages of experiments made under conditions suited to the best working of each apparatus. The figures in the columns under the names of the different apparatus give the degrees on the Fahrenheit thermometer at which the oil gave off an inflammable vapor (its flashing point).

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
OIL USED.	Tagliabue's Open.	Arnaboldi's Open.	Saybolt's.	Tagliabue's Small Closed.	Tagliabue's Large Closed.	Wisconsin State.	English Government.	Bernstein's.	Millspaugh's.	Mann's.	Foster's Automatic.	Salleron-Urbain.	Pease's
No. 1	110	118	120	111	117	107	103	130	111	95	119	These instruments do not record the flashing point.	
No. 2	111	121	124	115	118	109	102	128	107	96	......		
No. 3	119	122	122	112	118	108	102	130	108	95	118		
No. 4	97	96	97	90	93	86	76	90	81	75	96		

From an inspection of this table it will be seen that it is very important to know which apparatus has been used when an oil is said to have a given flashing point. In the case of No. 1 oil the range of temperature is from 95° to 130° Fahrenheit; with No. 2, the range is from 96° to 128°; with No. 3, from 95° to 130°; while No. 4 ranges from 75° to 97°.

The merits of each apparatus have been discussed in the details of experiments described later, and the general considerations from these experiments will be given here.

APPARATUS IN WHICH THE OIL SURFACE IS FREELY EXPOSED — THE "OPEN TESTERS."

In the testers marked I, II, III, kerosene oil always has a higher flashing point than in closed or partially closed apparatus. This is easily accounted for from the fact that in an open vessel, as is here used, the vapors can readily diffuse into the surrounding air as fast as they are formed; while in a closed vessel this diffusion is prevented the more closely the oil surface is covered. These "Open Testers" are the apparatus generally used by the oil refiners, more especially III, to determine, not the flashing point or temperature at which vapors are formed that make explosive mixtures with air; but the burning point or temperature at which the oil itself takes fire, usually called by the high-sounding but fearfully misleading name of "Fire Test."

As is stated later it is possible to show that an oil that will not flash below (say) 120° Fahrenheit in an "Open Tester," is nevertheless, giving off inflammable vapors twenty degrees below this temperature. Since, therefore, these open apparatus do not show us the temperature at which vapors are first formed, they are entirely untrustworthy for determining the safety of kerosene oil.

APPARATUS IN WHICH THE OIL SURFACE IS MORE OR LESS COVERED — THE "CLOSED TESTERS."

In regard to the "Closed Testers" the variations in results are principally due to faults in construction. In some cases the amount of water in the water-bath is so small that the oil gets heated too quickly and the flashing point is lowered beyond fairness.

In another case the cover of the oil-cup becomes overheated from the flash-jet and heats the surface of the oil. But by far the most important fault is the too small quantity of the oil used in the oil-cup. In most apparatus, both open and closed, the quantity of oil used is about two fluid ounces (60 c. c.) and the experiments with the above-named apparatus have proved that with Closed Testers, the more oil in the oil-cup, the lower the flashing point. And when we remember that an ordinary kerosene oil lamp holds about twelve fluid ounces (400 c. c.) of oil, a test with only two ounces is by no means a fair one. As a proof that this is true the experiments with apparatus VI and X bear witness. In the first of these (a poorly-constructed tester and loosely closed) the oil cup holds about eight ounces, and the flash point of No. 1 oil is 107° Fahrenheit; while with the last of the above mentioned apparatus where over ten ounces of oil were used, the flash point is only 95° Fahrenheit.

From a careful consideration of all these experiments the following conclusions may be drawn.

An oil tester should be of such construction that the oil vessel shall hold as much oil as is used in an ordinary kerosene lamp (say ten ounces); the apparatus for heating the oil shall consist of a water-bath capable of holding enough water that the oil in the oil vessel shall not rise more than two or three degrees Fahrenheit per minute, when the water-bath is heated with a small spirit-lamp. The oil vessel should be closely covered and a means of ignition should be used that will ignite the vapors formed without heating the oil surface. Finally the thermometer should be accurate and of that type which has the degrees engraved directly on the stem, sufficiently far apart to be read with ease, and with a milk-glass back-ground.

GENERAL CONCLUSIONS.

Of all the apparatus examined not one can be called perfectly satisfactory. Of the better class of these instruments Mann's apparatus must be given the first place; then comes the Wisconsin State tester, which with a few changes would make the most satisfactory instrument to be placed in the hands of an inspector. The changes necessary in this instrument are:— First, increase of capacity of both water and oil vessels, and secondly, a glass or partly glass instead of a copper cover. Of the various other apparatus examined little need be said beyond what is stated in the examination of each. Of the electric testers it may be stated that any advantages obtained from the use of electricity is more than overcome by the trouble necessary to maintain the galvanic battery and induction coil.

II. EXPERIMENTS.

In the examination of the various apparatus now in use for the purpose of testing kerosene oil, the first step was a comparison of all the thermometers used, with a normal thermometer made by Green of New York. This normal thermometer was tested, and it gave 212° as the boiling point of water in a copper-vessel and 32.7° as the point at which ice melted.

Of fifteen thermometers compared with the normal one, only six were found accurate, and some of them varied as much as two degrees of Fahrenheit scale. These thermometers were sold with the apparatus used, and had a variety of forms; but the majority were of the type with an exterior glass tube and a paper scale of degrees. The thermometers with exterior glass tubes are very sluggish in the movement of the mercury and are not suited for testing kerosene oil; more especially if the temperature to be noted is near the flashing point of the oil.

Thermometers with ivory or metallic scales of degrees attached to the thermometer tube are entirely unreliable and should not be used where

even a moderate degree of accuracy is needed. They are usually so constructed that the scale can easily be unintentionally displaced many degrees.

The most satisfactory thermometer to use is one with the degrees engraved directly upon the glass stem that carries the mercury, such glass stems having a strip of milk glass at the back, in order that the height of the mercury may be the more easily seen.

The merits of each apparatus examined will now be discussed in as much detail as necessary beyond that given in the various tables of experiments.

CONDITIONS OF EXPERIMENTS.

The various tests were made with as near the same conditions as possible, any variations being noted in the tables under the head of "Remarks." For the purpose of comparison each apparatus was tested with four different oils marked No. 1, No. 2, No. 3, No. 4. The oils Nos. 1 and 3 were the best sold in New York city, and No. 2 was pale amber colored oil, purchased at a small store on Second avenue, while No. 4 was a mixture of No. 2 with petroleum naphtha to reduce the flashing point.

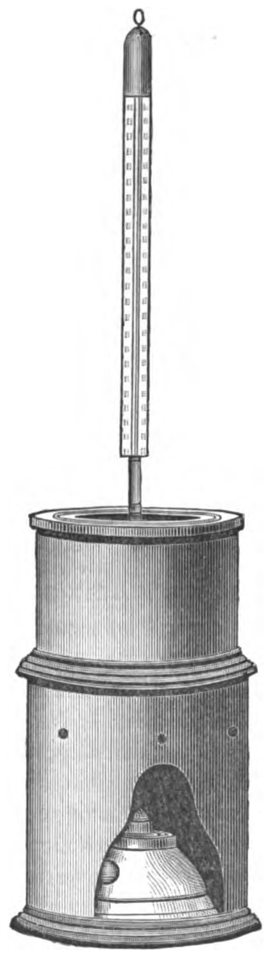
I. TAGLIABUE'S OPEN TESTER.

This is one of the oldest forms of apparatus used for testing kerosene oil; it is of the simplest construction, and consists of a reservoir to hold the oil to be examined, which sets in another vessel holding water. The vessel containing water is heated by means of a small spirit lamp surrounded by a metallic case which protects the flame from draughts of air. The means of ignition are left to the discretion of the operator, except that a small flame must be used. A very good flame is obtained by using an ordinary wooden tooth-pick, or better still a small gas-jet from a glass tube drawn to a fine point. In my experiments with this tester, I used either the tooth-pick or gas-jet as was most convenient, generally the latter, for this part of the manipulation does not affect the results to an appreciable degree.

The thermometer when hung upon the wire standard rising from the side of the apparatus, dips into the oil until the level of the latter is about a quarter of an inch above the mercury bulb.

The accompanying table exhibits the experiments made with this apparatus and the results obtained, with the conditions under which each experiment was made.

Tagliabue's Open Tester.



I. Tagliabue's Open Tester.

Oil used.	Density, degrees Be, 60° F.	Temperature. Water.	Temperature. Room.	Temperature. Oil.	Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
No. 1....	48	85	87	85	225	60	5.0	105	15	1	Oil stagnant.
No. 1....	do	do	do	do	do	do	6.0	105	16	2	Oil stagnant.
No. 1....	do	do	do	do	do	do	4.4	110	18	3	Oil stagnant.
No. 1....	do	do	do	do	do	do	4.1	110	15	4	Oil stagnant.
No. 1....	do	83	83	83	do	do	5.3	106	15	5	Oil stirred.
No. 1....	do	do	do	84	do	do	4.5	110	15	6	Oil stirred.
No. 2....	45	70	71	75	do	do	4.8	107	15	13	Oil stagnant.
No. 2....	do	78	79	78	do	do	6.7	109	15	14	Oil stagnant.
No. 2....	do	78	79	79	do	do	4.6	110	15	15	Oil stagnant.
No. 2....	do	78	79	79	do	do	7.5	112	15	16	Oil stirred.
No. 2....	do	78	79	79	do	do	6.2	113	15	17	Oil stagnant.
No. 2....	do	81	88	81	do	do	4.6	112	15	28	Oil stagnant; copper oil cup used.
No. 2....	do	81	88	81	do	do	5.0	115	15	29	Oil stagnant; copper oil cup used.
No. 2....	do	81	88	81	do	do	7.1	111	15	30	Oil stagnant; copper oil cup used.
No. 3....	48	65	65	64	do	do	2.4	118	25	128	Oil stagnant.
No. 3....	do	62	62	61	do	do	1.6	119	35	129	Oil stagnant.
No. 3....	do	63	62	63	do	do	1.8	119	36	130	Oil stagnant.
No. 4....	45	63	63	63	do	do	2.0	94	18	131	Oil stagnant.
No. 4....	do	63	63	63	do	do	2.0	96	19	132	Oil stagnant.
No. 4....	do	62	62	61	do	do	1.9	97	22	133	Oil stagnant.

SUMMARY.

In using this apparatus, a measured quantity of water was placed in the water bath each time an experiment was made, and the oil cup was filled with enough oil to cause the bulb of the thermometer to be immersed about half an inch, the oil being measured each time The flame of the spirit lamp was adjusted as well as possible to regulate for slow heating. In most of the experiments, the glass oil cup was used; but in some cases a copper one was substituted. The flash jet was either a small well-lighted match like a tooth-pick or a quarter-inch gas-jet from a fine glass tube, which was found to be neatest.

It will be noted from the experiments with the various oils, that rapid heating tends to lower the flash point, and with this apparatus it is very difficult to obtain a flame on the spirit lamp that will be small enough to heat the oil slowly. This difficulty with rapid heating is due to a too small quantity of water in the water-bath.

The material of which the oil cup is made, whether metal or glass, does not appear to have any very decided effect upon the results obtained by this apparatus. If the oil is stirred or stagnant there is no greater variation in the flash point than between experiments under the same conditions. In using this apparatus in a very quiet room, with a dark back-ground to the apparatus and the light coming from a side-window, it was noted that a sharp blue halo appeared around the flash-

flame about twenty degrees below the flash-point of the oil under examination. This phenomenon was noticed repeatedly and was always seen within a few degrees of the same temperature when the same oil was used. It is best noticed when a small gas-jet is used to flash the oil, and at about a quarter of an inch from the oil surface. It is not a permanent effect, due to any local heating of the oil, but is an enlargement of the flash-jet for a moment, due to the presence of inflammable vapor mixed with the surrounding air, but in too small quantity to ignite unless prevented from diffusing.

II. ARNABOLDI'S OPEN TESTER.

This apparatus is very much like Tagliabue's Open Tester; but it holds more water in the water bath and more oil in the oil cup than that apparatus. Another important feature of this apparatus, is the attachment on the side of the water bath which holds oil and has an arrangement by which a very small flame can be brought within a prescribed distance of the surface of the oil. In fact, it has a mechanical ignition attachment by means of a small oil-jet which is adjustable. There is another small oil lamp that goes with the apparatus but not attached; it can be used as a flash-jet. The results obtained by this apparatus are given in the following table:

II. Arnaboldi's Open Tester.

OIL USED.	Density, degrees Be, 60° F.	TEMPERATURE. Water.	Room.	Oil.	Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	REMARKS.
No. 1....	48	81	83	83	270	80	5.6	118	15	7	Oil stagnant; flashed with fixed jet.
No. 1....	do	do	do	do	do	do	3.3	118	15	8	Oil stagnant; flashed with fixed jet.
No. 1....	do	75	71	75	do	do	3.3	116	15	9	Oil stagnant; flashed with detached jet.
No. 1....	do	78	71	79	do	do	5.6	118	15	10	Oil stagnant; flashed with detached jet.
No. 1....	do	do	do	do	do	do	4.0	118	15	11	Oil stirred; flashed with detached jet.
No. 1....	do	77	71	77	do	do	5.8	116	15	12	Oil stirred; flashed with detached jet.
No. 2....	45	78	79	79	do	do	6.0	118	15	18	Oil stagnant; flashed with fixed jet.
No. 2....	do	do	do	do	do	do	3.6	122	15	19	Oil stagnant; flashed with fixed jet.
No. 2....	do	74	75	74	do	do	3.5	118	15	20	Oil stagnant; flashed with detached jet.
No. 2....	do	do	do	do	do	do	6.5	122	15	21	Oil stagnant; flashed with detached jet.
No. 2....	do	do	do	do	do	do	6.0	120	15	22	Oil stagnant; flashed with detached jet.
No. 2....	do	do	do	do	do	do	5.5	115	20	23	Oil stagnant; flashed with detached jet; therm'r ½'' deeper.
No. 2....	do	do	do	do	do	do	3.3	122	20	24	Oil stagnant; flashed with detached jet; thermometer as No. 23.
No. 2....	do	75	do	75	300	100	3.1	122	15	25	Oil stagnant; flashed with fixed jet; used copper oil cup.
No 2....	do	80	87	80	do	do	4.7	123	15	26	Oil stagnant; flashed with fixed jet; used copper oil cup.
No. 2....	do	do	do	do	270	80	3.7	121	15	27	Oil stagnant; flashed with fixed jet; used copper oil cup.
No. 4....	45	60	82	60	do	do	4.0	95	15	63	Oil stagnant; flashed with fixed jet; oil and water cooled.
No. 4....	do	do	78	do	do	do	3.3	97	15	64	Oil stagnant; flashed with fixed jet; oil and water cooled.
No. 3....	48	62	62	62	do	do	1.4	123	45	134	Oil stagnant.
No. 3....	do	do	do	do	do	do	1.6	122	40	135	Oil stagnant.
No. 3....	do	60	60	60	do	do	3.0	121	25	136	Oil stagnant.

SUMMARY.

What has been said in regard to Tagliabue's Open Tester is equally true of Arnaboldi's apparatus. It has one merit over Tagliabue's apparatus, in that it has a mechanical flash-jet which brings a small flame whithin a prescribed distance of the oil-surface, and in the same place upon that surface, every time it is desired to test the oil. But this does not appear to have any important effect upon the flash-point; for by using the detached jet sent with the apparatus, the same flash-points are obtained.

In this apparatus the water and oil were measured for each experiment, as in the case of Tagliabue's open apparatus.

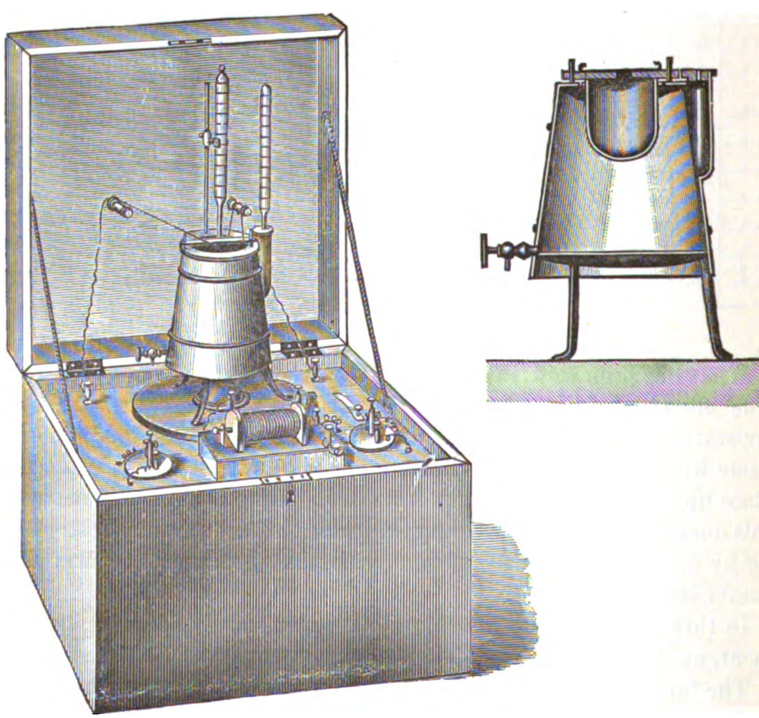
The larger quantity of water and oil used in this apparatus make it easier to heat the oil slowly, and therefore raises the flash-point of the same oil higher than with Tagliabue's apparatus.

III. SAYBOLT'S ELECTRIC TESTER.

In this apparatus, electricity is used as a means of igniting the vapors given off by a sample of kerosence. The outfit consists of a water-bath shaped like a truncated cone, a glass oil cup, an ebonite bar carrying two platinum wires, an induction coil, and two pint Grenet cells of a galvanic battery with the necessary wires for attachment. The ebonite bar rests upon the glass oil cup with the platinum wires upon the under side, and the cup is filled with oil to within an eighth of an inch of the platinum wires. There are two thermometers, one in the oil cup and another in the water-bath. When the oil arrives at the desired temperature, a series of sparks are made to pass between the platinum wires by means of a key which serves to make and break the circuit between the battery cells and the induction coil.

The following table gives the details of results obtained with this apparatus:

Saybolt's Electric Tester.



III. *Saybolt's Electric Tester.*

OIL USED.	Density, degrees Be, 60° F.	TEMPERATURE. Water.	Room.	Oil.	Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	REMARKS.
No. 2....	45	80	84	81	880	60	1.8	134	30	31	Thermometer ¼ in. deep; spark ¼ in. from oil.
No. 2....	do	do	83	do	do	70	2.1	123	30	32	Thermometer ¼ in. deep: spark ¼ in. from oil.
No. 2....	do	do	do	do	do	60	2.6	132	30	33	Thermometer ¼ in. deep; spark ¼ in. from oil.
No. 2....	do	do	do	do	do	70	2.7	125	30	34	Thermometer ¼ in. deep; spark ¼ in. from oil.
No. 3....	48	79	81	81	do	do	2.5	126	30	35	Thermometer and spark as No. 34
No. 3....	do	do	do	do	do	do	2.5	121	30	36	Thermometer and spark as No. 34
No. 3....	do	do	do	do	do	do	2.6	121	30	37	Thermometer and spark as No. 34
No. 3....	do	do	82	65	do	do	3.6	124	30	38	Thermometer and spark as No. 34; oil cooled.
No. 3....	do	do	do	63	do	do	2.5	122	30	39	Thermometer and spark as No. 34; oil cooled.
No. 4....	45	80	81	80	do	do	2.5	98	20	44	Thermometer and spark as No. 34
No. 4....	do	do	do	do	do	do	2.4	102	20	45	Thermometer and spark as No. 34
No. 4....	do	do	do	do	do	do	2.3	97	20	46	Thermometer and spark as No. 34
No. 1....	48	do	do	do	do	do	3.0	120	30	47	Thermometer and spark as No. 34
No. 1....	do	do	82	do	do	do	3.1	124	30	48	Thermometer and spark as No. 34
No. 1....	do	do	83	do	do	do	2.6	120	30	49	Thermometer and spark as No. 34

SUMMARY.

As in the other cases before mentioned, the water and oil used in this apparatus were both measured for each experiment. The thermometer was always immersed in oil in the oil cup so that the bulb was about a quarter of an inch below the oil surface.

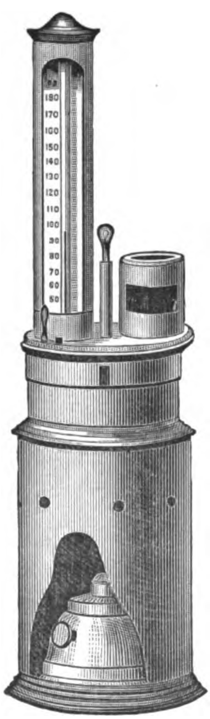
This apparatus has an advantage over the other open testers, in that it has a small fixed means of igniting the vapors, viz.: the electric spark. As will be seen by the table of experiments, the distance of the spark from the oil surface makes an important difference in the temperature of the flash point; but in practice, this is easily obviated by measureing the oil used.

The great difficulty with this apparatus is the fact, that you have to look after a galvanic battery with its corrosive liquids. And, furthermore, this battery is constantly changing its strength and consequently the intensity of the electric spark varies. In the experiments with this apparatus, it was also found that just at the moment when you wished the spark to pass between the platinum wires, it refused to do so; in fact the means of ignition are too uncertain for practical work. Although the apparatus works admirably when everything connected with the battery is fresh, after a few days it is not easy to adjust it to be sure to get a spark when you want it.

IV. TAGLIABUE'S SMALL CLOSED TESTER.

This is an apparatus with a cover containing a kind of short chimney and a couple of valves to let in air and cause the vapor to rise into the chimney, where a flame is applied. The valves are opened by depressing a spring with a rod passing through the cover of the oil cup. In this form of the apparatus, the oil cup is of metal and the thermometer is fitted into a heavy metal case which screws into the top of the cover and dips into the oil cup. When the cover carrying the thermometer is placed upon the apparatus, a sliding valve allows of the filling of the oil cup with oil. The water-bath is filled to an overflow hole, and heated by a small spirit lamp. When the oil arrives at the desired temperature, the flash is seen by applying a small flame in the chimney or box upon the cover and simultaneously depressing the valves in the cover to allow air to enter.

Tagliabue's Closed Tester.



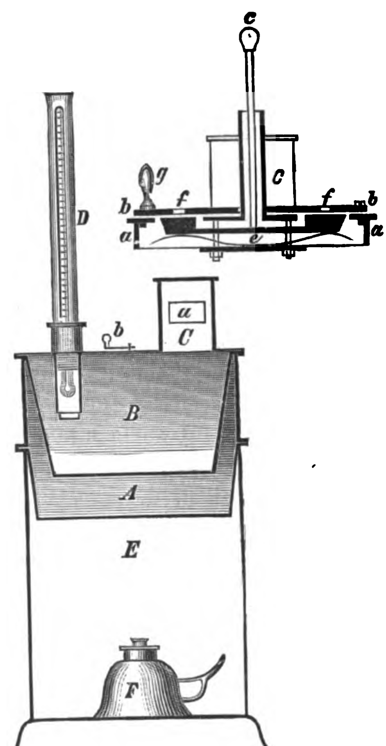


Fig. 1. Exterior view.

Fig. 2. Shows section of old form, and also section of the valve mechanism of new form.

IV. Tagliabue's Small Closed Tester.

OIL USED.	Density, degrees Be, 60° F.	TEMPERATURE.			Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	REMARKS.
		Water.	Room.	Oil.							
No. 4....	45	76	74	74	50	75	4.0	90	6	105	Flashed with ¼ in. gas-jet.
No. 4....	do	do	do	70	do	do	2.5	93	12	106	Flashed with ¼ in. gas-jet.
No. 4....	do	60	77	67	do	do	2.5	90	10	107	Flashed with ¼ in. gas-jet.
No. 2....	45	60	77	70	do	do	3.5	110	14	108	Flashed with ¼ in. gas-jet.
No. 2....	do	54	do	68	do	do	3.4	114	16	109	Flashed with ¼ in. gas-jet.
No. 2....	do	53	do	72	do	do	3.3	115	15	110	Flashed with ¼ in. gas-jet.
No. 3....	48	62	60	63	do	do	3.2	112	18	137	Flashed with ¼ in. gas-jet.
No. 3....	do	60	60	60	do	do	3.0	112	20	138	Flashed with ¼ in. gas-jet.
No. 3....	do	62	60	62	do	do	3.3	112	18	139	Flashed with ¼ in. gas-jet.
No. 1....	48	55	55	57	do	do	3.1	110	20	140	Flashed with ¼ in. gas-jet.
No. 1....	do	52	52	54	do	do	5.1	111	15	141	Flashed with ¼ in. gas-jet.

SUMMARY.

The heavy metal of which this tester is made causes very rapid heating of the oil, and it is almost impossible to prevent this by any care in the manipulation. Another difficulty with this apparatus is the trouble necessary to clean the cover and valves between each sample of oil tested. In fact, the cooling of the apparatus and cleaning ready for a new test takes about fifteen minutes.

While using this apparatus, the enlargement of the ignition flame noticed with the open testers in a quiet room, is still more readily seen in the dark flash box of this tester, and at temperatures corresponding closely with those seen in the open tester with the same oil.

V. TAGLIABUE'S LARGE CLOSED TESTER

Is almost exactly like the small tester in design, but of larger dimensions; and the metallic oil cup is replaced by one made of glass. The method of testing is exactly the same as with the smaller tester.

V. Tagliabue's Large Closed Tester.

OIL USED.	Density, degrees Be at 60° F.	TEMPERATURE.			Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	REMARKS.
		Water.	Room.	Oil.							
No. 4....	45	67	79	67	210	100	1.7	92	17	111	Flashed with ¼ in. gas-jet.
No. 4....	do	65	do	70	do	do	1.3	94	20	112	Flashed with ¼ in. gas-jet.
No. 2....	45	63	80	60	do	do	2.2	119	30	113	Flashed with ¼ in. gas-jet.
No. 2....	do	50	do	65	do	do	2.54	118	30	114	Flashed with ¼ in. gas-jet.
No. 1....	48	55	57	57	do	do	2.0	116	35	142	Flashed with ¼ in. gas-jet.
No. 1....	do	56	57	57	do	do	2.6	117	28	143	Flashed with ¼ in. gas-jet.
No. 3....	48	do	do	do	do	do	2.6	115	25	144	Flashed with ¼ in. gas-jet.
No. 3....	do	do	58	58	do	do	1.4	118	46	145	Flashed with ¼ in. gas-jet.
No. 3....	do	do	60	60	do	do	2.0	118	33	150	Flashed with ¼ in. gas-jet.

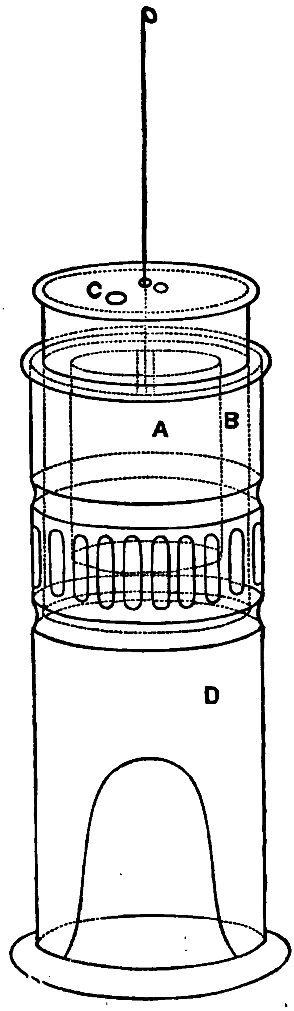
SUMMARY.

What has been said in regard to the small tester of Tagliabue, in the matter of weight of metal and valves, is equally true of the large apparatus. As will be seen from the table the quantity of water in the water bath is larger than in the small apparatus, and the rate of heating the oil is consequently more manageable.

VI. WISCONSIN STATE TESTER.

This apparatus consists of a water bath and a deep cylindrical oil reservoir, which is loosely covered with a copper plate through which passes the thermometer. This cover also has another hole through which the flame is applied to obtain the flash. It is of the simplest construction in copper, and the means of flashing are a small flame from a thin waxed thread.

Wisconsin State Tester—one-third actual size.



A. Oil cup. B. Water bath. C. Flash opening. D. Jacket.

VI. Wisconsin Tester.

OIL USED.	Density, degrees Be at 60° F.	Temperature.			Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
		Water.	Room.	Oil.							
No. 2....	45	75	82	73	215	240	5.3	105	10	95	Flashed with ¼ in. gas-jet.
No. 2....	do	do	77	78	do	do	2.8	109	12	96	Flashed with ¼ in. gas-jet.
No. 2 ...	do	78	78	do	do	do	2.0	110	18	97	Flashed with ¼ in. gas-jet.
No. 2....	do	do	do	do	do	do	2.0	109	18	98	Flashed with ¼ in. gas-jet.
No. 4....	45	76	74	73	do	do	1.6	86	10	99	Flashed with ¼ in. gas-jet.
No. ' ...	do	do	do	70	do	do	2.0	86	10	100	Flashed with ¼ in. gas-jet.
No. 3....	48	76	74	70	do	do	2.4	109	18	101	Flashed with ¼ in. gas-jet.
No. 3....	do	do	do	do	do	do	2.5	108	17	102	Flashed with ¼ in. gas-jet.
No. 1....	48	76	74	72	do	do	2.5	107	16	103	Flashed with ¼ in. gas-jet.
No. 1....	do	do	do	70	do	do	2.5	106	16	104	Flashed with ¼ in. gas-jet.

SUMMARY.

Since this tester uses a comparatively large quantity of oil, it approaches the conditions that obtain in burning a kerosene lamp. Its management is simple, it is easily cleaned, and if it held more oil and had a closer cover, would be almost perfect as an oil-tester. The water bath also should hold more water in proportion to the oil used.

A slight difficulty arises in seeing the flash through the hole in the cover, owing to the reflection of the inside, which could probably be overcome by making the inside of the tester dark-colored. This is the only tester examined which has an adjustable wick to the spirit-lamp used for heating, a matter too important to be overlooked.

VII. ENGLISH GOVERNMENT TESTER — ABEL'S TESTER.

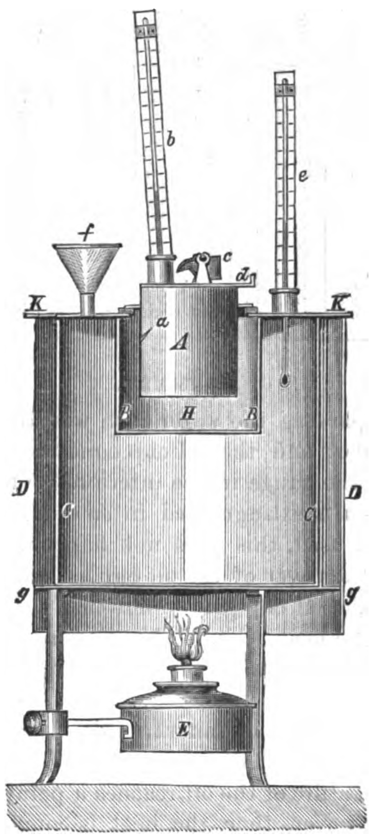
This is the apparatus used by the English government inspectors under the provisions of the Petroleum Act of 1879. The oil cup is a cylindrical vessel, two inches deep, and two and one-fifth inches high inside. The vessel has a close-fitting cover, which carries the thermometer and flash lamp. This cover is also provided with a sliding arrangement, which simultaneously opens three square openings in the cover, and also dips the flame of the flash lamp into the center opening by the same movement. This oil vessel has a filling gauge on the inside.

The oil cup and its attachments fit into an air bath, three inches in diameter and two and one-half inches deep, which in turn fits into a water bath five and one-half inches in diameter and five and three-quarter inches deep. A ring of ebonite prevents the contact of the ring of the oil cup with the top of the air bath, so that the heating

shall be only by means of air heated by the water bath. The water bath is provided with a thermometer, a funnel to fill it and an overflow gauge.

An outer case to surround the water bath and a spirit lamp complete the outfit. The results from this apparatus are seen below.

English Government (Abel's) Tester.



VII. *English Government (Abel's) Tester.*

Oil used.	Density, degrees Be, 60° F.	Temperature. Water.	Temperature. Room.	Temperature. Oil.	Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
No. 4....	45	78	83	82	2130	75	0.4	85	10	50	Flashed with oil-jet.
No. 4....	do	99	83	58	do	do	2.0	76	10	51	Flashed with oil-jet.
No. 4....	do	102	do	52	do	do	2.4	76	10	52	Flashed with oil-jet.
No. 4....	do	100	do	52	do	do	2.0	78	10	53	Flashed with oil-jet.
No. 4....	do	130	86	52	do	do	4.3	78	10	54	Flashed with gas-jet.
No. 4....	do	do	do	do	do	do	4.0	75	10	55	Flashed with gas-jet.
No. 4...	do	do	85	do	do	do	3.6	74	10	56	Flashed with gas-jet.
No. 2....	45	do	85	54	do	do	2.6	102	20	57	Flashed with gas-jet.
No. 2....	do	do	do	55	do	do	2.2	102	25	58	Flashed with gas-jet.
No. 2....	do	do	82	do	do	do	2.4	102	20	59	Flashed with gas-jet.
No. 3....	48	do	do	56	do	do	2.2	102	25	60	Flashed with gas-jet.
No. 3....	do	do	do	do	do	do	2.2	102	25	61	Flashed with gas-jet.
No. 3....	do	do	78	55	do	do	2.0	103	25	62	Flashed with gas-jet.
No. 1....	do	do	79	do	do	do	1.7	106	30	65	Flashed with gas-jet.
No. 1....	do	do	do	do	do	do	1.8	104	30	66	Flashed with gas-jet.
No. 1....	do	do	85	do	do	do	2.2	102	25	67	Flashed with gas-jet.
No. 1....	do	do	do	do	do	do	2.0	102	25	68	Flashed with gas-jet.

SUMMARY.

In using this apparatus, the water bath was filled till water ran out of the overflow tube; and the oil cup contained oil enough to just cover the point of the gauge in the interior. When an oil-jet is used to flash the vapor, it is extinguished in so doing; but when a gas-jet of the same size is used, this does not happen. When the little oil lamp attached to the cover of the oil cup is used as a means of ignition, the cover of the oil cup gets so hot that the hand can only, with difficulty, endure the heat of it. This heat can readily be communicated to the oil down the sides of the oil cup and cause a local overheating of the fluid.

When a gas-jet is used, this same trouble of heating the cover of the oil cup is also observed. This can be overcome by not lighting the jet until the temperature of the oil reaches a point a few degrees below the flash point; but even then the heat is communicated so rapidly through the gun-metal attachments on the cover, that there is a danger of overheating the upper portions of the oil. Perhaps a glass flash-jet would eliminate this difficulty.

In the directions for using this tester, the operator is told to heat the water bath to 130° Fahrenheit, and then place the oil cup, containing the proper quantity of oil, in position. When the oil begins to rise in temperature, the slider upon the cover of the oil cup is opened and the flame dips into the center opening while a pendulum

makes three beats. This appears to be an unnecessary amount of caution, since the results are just as concordant without any pendulum beats to guide the operator.

According to the English Petroleum Act of 1879, a flashing point of 73° Fahrenheit upon this apparatus is equivalent to 100° Fahrenheit with an open tester. In the apparatus used in the foregoing experiments it will be seen that this ratio is not quite fulfilled. But it is most remarkable that such a method of stating the results should be so recommended, in face of the fact that the oil gives off inflammable vapors at much lower temperatures than 100° Fahrenheit. It is a proof of the correctness of observations made elsewhere in this investigation, that open testers are worthless in determining the safety of kerosene oil.

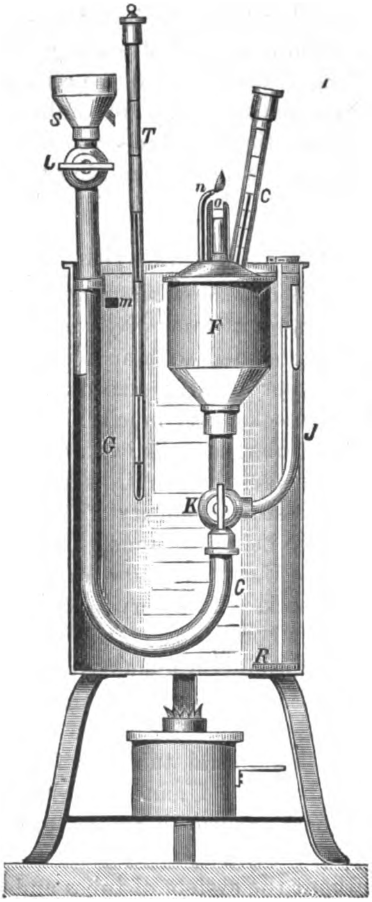
VIII. BERNSTEIN'S TESTER.

This apparatus is designed to show whether an oil does or does not give off an inflammable vapor at some given temperature. The outfit consists of a water bath, provided with an agitator and a spirit lamp, to heat it. Into this water bath is placed a somewhat complicated system of tubes and stop-cocks, very much like the letter U with the upper part of one limb enlarged. The enlarged part of the limb is used as an oil cup and the rest of the U is filled with water. Into the oil cup is placed a measured quantity of the oil to be tested, the stop-cock under the oil cup being previously closed. Water is now run into the other limb of the U, until it flows over a small tube communicating with the stop-cock. This serves to make the level of the water and oil the same in both limbs of the U when the stop-cock is opened. Into the top of the oil cup fits a cover, which carries two jets for oil; one of these jets is central and is surrounded with an annular space communicating with the interior of the oil cup, while the other jet is upon one side of this central tube. A funnel with a stop-cock fits into the narrow limb of the U, and also holds water when the stop-cock is closed. There are two thermometers, one in the oil cup and the other in the water bath.

The water bath without the system of tubes and oil cup is raised to the desired temperature by means of the spirit lamp. The system of tubes containing water and oil as described above are now placed in the water bath, and, the spirit lamp having been removed, the temperture of the oil is allowed to rise until it reaches that of the water bath the side jet upon the cover of the oil cup is now ignited, and by turning the stopcock of the funnel in the small limb of the U, the water runs down, raises the level of the oil in the oil cup, and thus forces the vapors up through the annular space of the cover into contact

with the jet which is immediately over it. As the vapors rise and are ignited by the side jet, they should also set fire to the jet within the annular space.

Bernstein's Tester.



VIII. Bernstein's Tester.

Oil used.	Density, degrees Bé at 60° F.	Temperature.			Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
		Water.	Room.	Oil.							
No. 1....	48	87	85	85	1300	55	1.8	130	30	69	
No. 1....	do	131	do	do	do	do	6.4	130	10	70	Water bath heated before tube with oil added.
No. 1....	do	135	86	75	do	do	8.0	126	6	71	Water bath heated before tube with oil added.
No. 1....	do	do	do	82	do	do	13.6	127	5	72	Water bath heated before tube with oil added.
No. 1....	do	do	do	do	do	do	8.8	130	6	73	Water bath heated before tube with oil added.
No. 4....	45	125	do	73	do	do	16.0	95	3	74	Water bath heated before tube with oil added.
No. 4....	do	122	do	75	do	do	10.0	90	3	75	Water bath heated before tube with oil added.
No. 4....	do	112	do	do	do	do	8.3	100	4	76	Water bath heated before tube with oil added.
No. 4....	do	108	85	74	do	do	12.5	99	3	77	Water bath heated before tube with oil added.
No. 4....	do	105	do	76	do	do	7.3	98	4	78	Water bath heated before tube with oil added.
No. 4....	do	125	do	74	do	do	17.3	90	3	79	Water bath heated before tube with oil added.
No. 4....	do	125	do	73	do	do	18.0	90	3	80	Water bath heated before tube with oil added.
No. 4....	do	do	do	75	do	do	13.0	88	3	81	Water bath heated before tube with oil added.
No. 4....	do	do	do	do	do	do	11.0	86*	3	82	Water bath heated before tube with oil added.
No. 4....	do	do	do	do	do	do	11.0	86*	3	83	Water bath heated before tube with oil added.
No. 3....	48	do	88	70	do	do	5.4	130	12	84	Water bath heated before tube with oil added; oil cooled in tubes.
No. 3....	do	135	do	do	do	do	6.0	130	12	85	Water bath heated before tube with oil added; oil cooled in tubes.
No. 3....	do	136	do	do	do	do	6.6	130	11	86	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	45	136	84	70	do	do	9.9	129	7	87	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	do	do	do	do	do	18.3	125	4	88	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	130	do	do	do	do	17.0	120	4	89	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	120	do	do	do	do	6.6	116*	8	90	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	125	do	do	do	do	4.6	125	14	91	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	80	82	do	do	do	1.8	130	36	92	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	132	do	do	do	do	6.4	128	11	93	Water bath heated before tube with oil added; oil cooled in tubes.
No. 2....	do	135	do	do	do	do	10.8	128	7	94	Water bath heated before tube with oil added; oil cooled in tubes.

* Oil would not flash at these temperatures.

SUMMARY.

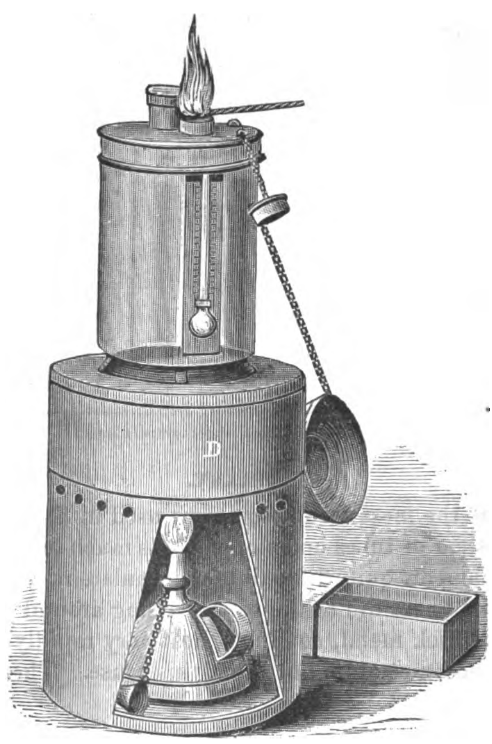
This tester is the most troublesome one used in the whole investigation. The system of tubes and stop-cocks is much too complicated for practical work and are quite difficult to manipulate rapidly. The ignited jet which serves to set fire to the vapors rising around the central jet, being made of thick metal, conducts heat very rapidly and the cover of the oil cup becomes quite hot from this cause. There is also great

difficulty in catching the flash point, owing to the rapid heating and the very great uncertainty of igniting the central jet, which is the index of the flash point. As in other testers, rapid heating lowers the flash point. It is often possible to see the vapors ignited by the side jet while the central jet refuses to take fire. As a consequence of these difficulties, and the uncertainty of the temperature at which the oil flashes, the results by this apparatus are much higher than with any other used, even open testers.

IX. MILLSPAUGH'S TESTER.

In this apparatus, the glass vessel that contains the oil stands about nine-tenths out of the water bath, only one-tenth of the lower part being immersed. The water bath is a cylindrical brass vessel, heated by a spirit lamp. The top of the glass oil cup has a rather loose cover with two holes in it; one of these holes opening immediately below the cover, and the other has a tube reaching about one-half inch lower down. A thermometer attached to the cover is immersed in the oil. The water bath is heated by the spirit lamp and the flash point obtained by removing the cap from the lowest outside opening and applying a small lighted match.

Millspaugh's Tester.



IX. Millspaugh's Tester.

OIL USED.	Density, degrees Be, 60° F.	Temperature. Water.	Temperature. Room.	Temperature. Oil.	Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
No. 2....	45	52	82	60	180	210	2.3	107	25	116	Flashed with ¼ in. gas-jet.
No. 2....	"	do	do	56	do	do	2.9	108	25	117	Flashed with ¼ in. gas-jet.
No. 4....	45	57	82	60	do	do	2.2	87	15	118	Flashed with ¼ in. gas-jet.
No. 4....	"	62	86	63	do	do	2.0	81	12	119	Flashed with ¼ in. gas-jet.
No. 4....	"	do	do	61	do	do	2.0	81	12	120	Flashed with ¼ in. gas-jet.
No. 3....	48	58	86	60	do	do	2.8	108	20	121	Flashed with ¼ in. gas-jet.
No. 3....	"	56	88	63	do	do	2.5	108	20	122	Flashed with ¼ in. gas-jet.
No. 1....	48	57	57	58	do	do	2.5	110	25	146	Flashed with ¼ in. gas-jet.
No. 1....	"	56	58	58	do	do	2.7	112	25	147	Flashed with ¼ in. gas-jet.

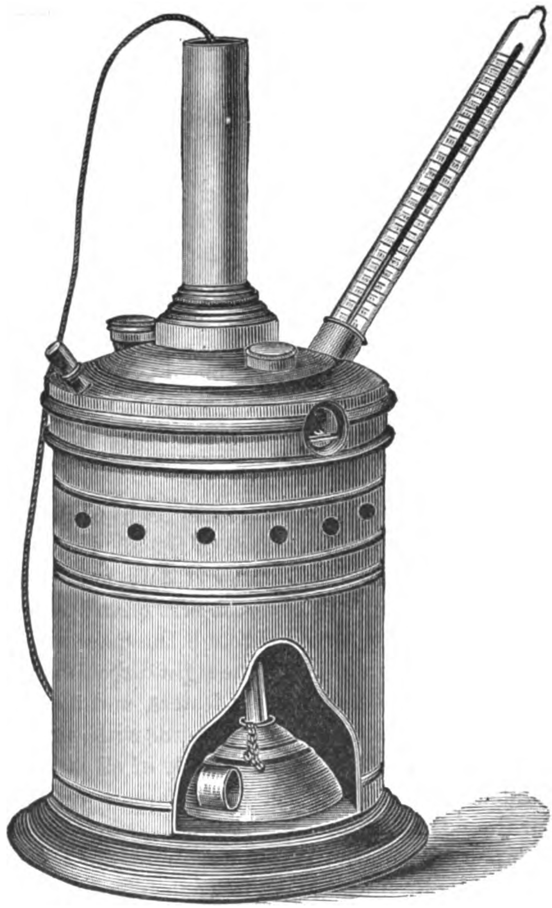
SUMMARY.

We have here a tester where an effort has been made to prevent as far as possible the heating of the surface of the oil. But the looseness of the cover and the small space under it does not allow of the accumulation of vapor enough to detect the first quantities of it that are evolved by the oil; they are forced through the space around the cover and lost. Nevertheless this a step in the right direction since there is a larger quantity of oil used than in most testers, and a sufficiently slow means of heating. One very important fault with this apparatus is the immersed thermometer. When a sample of oil is white and clear there is no difficulty in reading the thermometer degrees; but with colored oils or those that are opalescent this becomes an impossibility. There is also much irregularity in the heating of the oil, owing to the small surface of the oil-cup exposed to the water-bath which causes convection in the oil.

X. MANN'S TESTER.

In this apparatus we come nearest to the conditions that obtain in an ordinary kerosene lamp. In fact the apparatus is essentially a metallic lamp in which the wick holder is replaced by a tube closed above by an india-rubber stopper. An opening at the side which closes from within by a little flap-valve serves for the introduction of a small flame for ignition. The thermometer is placed in a small tube closed below that is fixed down into the interior of the lamp. There are various openings in the top of the lamp serving to introduce the oil and as vents for the expanding gases within. There is a water bath with spirit lamp for heating to complete the outfit.

Mann's Tester.



X. Mann's Tester.

OIL USED.	Density, degrees Be at 60° F.	Temperature. Water.	Temperature. Room.	Temperature. Oil.	Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
No. 8....	48	57	88	62	240	320	2.4	94	15	123	Blew up with ½ in. gas-jet.
No. 3....	do	56	84	64	do	do	2.4	100	20	124	Not blown up but flashed.
No. 3....	do	50	84	64	do	do	2.0	95	18	125	Blew out valve not at plug.
No. 1....	48	50	73	56	do	do	1.7	96	25	126	Blew up.
No. 1....	do	do	70	53	do	do	2.6	95	18	127	Blew up, but faint.
No. 2....	45	56	60	60	do	do	1.8	93	22	148	Blew out at valve.
No. 2....	do	do	do	do	do	do	2.5	98	18	149	Apparatus filled with flame.
No. 4....	45	56	65	65	do	do	.7	75	16	151	Blew up.
No. 4....	do	do	do	do	do	do	.7	75	15	152	Blew out at valve.

SUMMARY.

The greatest fault of this apparatus is the fact that it is almost impossible to adjust the stopper in the tube so that it will blow out and not cause the flame to be ejected from the valve at the side. A larger water-bath would also be an improvement to this apparatus; and a better means of getting the flame into the lamp to ignite the vapor is also necessary.

This apparatus could be so modified as to cover almost all the requirements of a good tester.

In using this tester it was noticed that sometimes the vapor had not force enough to drive out the stopper but the whole interior of the apparatus was filled with flame. It appears to be necesary to have just the right admixture of vapor and air to eject the stopper.

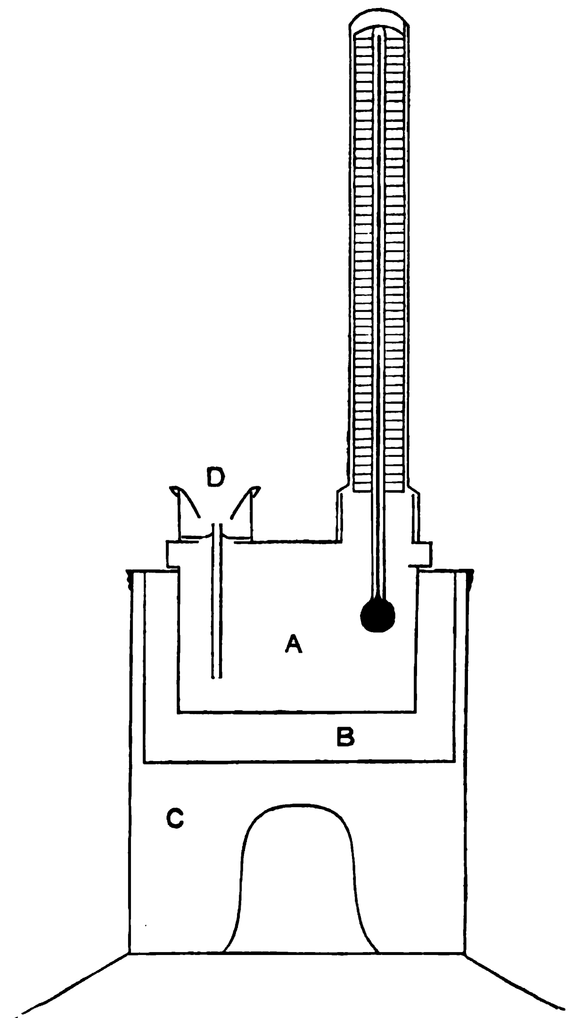
Another difficulty with this tester, which also applies to several others, is that the distance between the flame of the spirit-lamp and the bottom of the water-bath is too small and the cold metal often extinguishes the spirit-lamp by cooling the flame rapidly.

Since the thermometer is set into a tube closed at the lower end and only receives its heat by conduction through this tube and some oil into which it dips, this method of recording the temperature is objectionable as the rate of conduction is slow.

XI. FOSTER'S AUTOMATIC (OHIO STATE) TESTER.

In this, as in the other testers, we have a water-bath and oil cup Both of these have good well defined filling guages; and the oil-cup is covered. The horizontal cross sections of both water-bath and oil-cup are ellipses. In the cover of the oil-cup there are two openings; into one of these passes the thermometer leaving a space around it, and in the other is a tube carrying a wick which dips into the oil-cup. The wick in the small tube is ignited at a given temperature and causes a current down the space around the thermometer and up around its own flame. When vapor rises the jet ignites it and its explosion extinguishes the jet, thus becoming an index of the flashing-point of an oil.

Fosters' Automatic (Ohio State) Tester, one-third actual size.



Oil-cup has elliptical horizontal section and water-bath and outside jacket take the same form. A. Oil-Cup. B. Water-bath. C. Jacket. D. Flash jet.

XI. Foster's Automatic Tester (Ohio).

OIL USED.	Density, degrees Bé, 60° F.	Temperature. Water.	Temperature. Room.	Temperature. Oil.	Cubic centimetres in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
No. 3....	48	56	58	56	240	250	2.1	116	32	155	Flash-jet lit at 100°.
No. 3....	do	do	do	do	do	do	1.9	115	34	156	Same as 155.
No. 3....	do	50	55	50	do	do	1.7	120	44	157	Flash-jet lit at beginning.
No. 3....	do	do	do	do	do	do	2.1	119	37	158	Same as 157.
No. 3...	do	do	60	52	do	do	2.3	112	30	159	Wick removed from flash-jet; used gas-jet.
No. 3....	do	61	65	60	do	do	1.9	110	31	160	Same as 159.
No. 3....	do	51	58	51	do	do	1.9	110	35	161	Same as 159.
No. 3....	do	60	75	70	do	do	1.5	124	39	162	Same as 157.
No. 3....	do	58	70	70	do	do	1.8	120	32	163	Same as 155.
No. 1....	48	57	80	70	do	do	1.9	121	31	164	Flash-jet lit at 100°.
No. 1....	do	60	80	72	do	do	2.0	119	28	165	Same as 164.
No. 1....	do	60	65	60	do	do	1.8	118	36	166	Same as 164.
No. 1....	do	do	do	do	do	do	2.1	119	32	167	Flash-jet lit at beginning.
No. 1....	do	do	68	63	do	do	2.0	119	32	168	Same as 167.
No. 1....	do	63	do	do	do	do	1.7	113	34	169	Wick removed from flash-jet; used gas-jet.
No. 1....	do	62	do	64	do	do	2.0	110	28	170	Same as 169.
No. 1....	do	57	do	63	do	do	1.9	110	29	171	Same as 169.
No. 4...	45	60	52	57	do	do	1.4	97	33	172	Flash-jet lit at 80°.
No. 4....	do	52	54	55	do	do	1.8	95	26	173	Same as 172.
No. 4....	do	55	85	68	do	do	1.6	95	21	174	Same as 172.
No. 4....	do	60	85	64	do	do	1.3	77	14	175	Wick removed from flash-jet; used gas-jet.
No. 4....	do	58	66	do	do	do	1.3	76	13	176	Same as 175.
No. 4....	do	60	72	do	do	do	1.3	76	13	177	Same as 175.

SUMMARY.

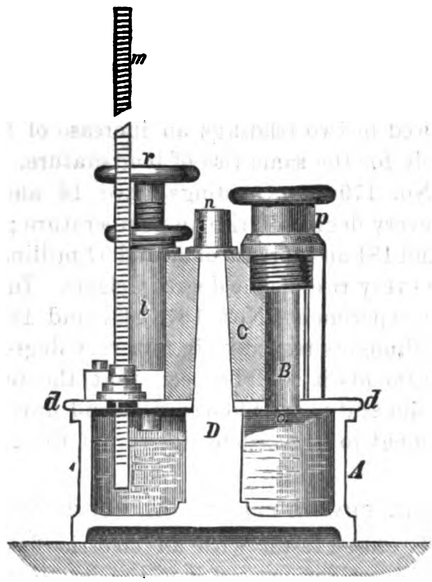
In using this tester some very important defects have been noted. In the first place, it does not matter much whether the flash-jet is lit at 100° Fahrenheit, as given in the directions, or at the beginning of the experiments; the results are not very concordant in either case, as may be seen from an inspection of the table. But what is more important than this is the fact that a lower flash-point can be obtained with this apparatus by not lighting the flash-jet and using a small (¼ inch) gas-jet as a means of igniting the vapor. This was found to be true in every case, and goes to prove that the flame in the wick-tube of the apparatus simply causes a current over the surface of the oil, which carries off the vapors mixed with too much air to cause an explosion until they become of considerable density. This apparatus has some good points. It holds considerably more oil than oil testers generally; its well-defined filling guages are to be admired, and the adjustable spirit-lamp for heating the water-bath is too seldom seen with oil-testers to pass it without commendation. Nevertheless the apparatus fails as a safety oil-tester, since it is little better than an open tester, as can be seen from the experiments with it.

XII. SALLERON-URBAIN (PARIS) APPARATUS.

In his apparatus an effort has been made to ascertain the safety of kerosene oil by determining the tension of the vapor of a sample at a given temperature. It is claimed by the inventors that the lower the flashing point of the oil the greater the tension of its vapor at any given temperature. The apparatus consists of a shallow circular metallic vessel having a spindle in the centre, a cover through which passes a manometer tube and thermometer; this cover also contains two other openings. Upon the top of the cover a heavy metal tube is fitted, which works horizontally upon the spindle that passes several inches above the upper surface of the cover of the apparatus. This last tube is so arranged that by moving it through a small arc upon the spindle an opening below may be closed or opened at will. A solid plunger is fitted through another opening in the cover; and a screw cap to the heavy movable tube completes the apparatus.

To use this apparatus, the cover is placed upon the shallow vessel and contains the manometer tube, thermometer and plunger, all tightly screwed into stuffing boxes; upon the spindle is now placed the movable heavy tube in such a position that the opening into the cover below is free. By means of a pipette fifty cubic centimeters of water are run into the shallow vessel through the heavy metal tube, the tube is moved through its arc and the opening below closed. The tube itself is now filled with the oil to be tested, the cap upon the oil-tube screwed down tight, and the whole immersed in water till the thermometer reads fifteen degrees Celsius. At this temperature, the plunger is screwed down until the water in the manometer tube stands at zero. The oil tube is now moved back through its arc and the oil it contains falls into the water below, the column in the manometer tube rises and gives in millimeters the tension of the vapor of the oil for that temperature. From a number of experiments by the inventors, a tension of sixty-four millimeters of water at fifteen degrees Celsius is considered the minimum allowable for a safe oil.

Salleron-Urbain Apparatus.



A. Water reservoir. B. Oil-tube. M. Manometer. R. Plunger to adjust level in manometer.

XII. Salleron-Urbain (Paris) Apparatus.

OIL USED.	TEMPERATURE.		Tension of vapor in millimeters of water.	Reference number.	REMARKS.
	Degrees Centigrade.	Degrees Fahrenheit.			
No. 3	15.5	60	8	178	
No. 3	15.0	59	24	179	At 16°. 5 C. — 45 mm.; at 28°. 0 C. — 240 mm.
No. 3	15.0	59	6	180	At 19°. 0 C. — 138 mm.
No. 3	15.0	59	8	181	At 18°. 0 C. — 120 mm.
No. 1	15.0	59	14	182	At 16°. 0 C. — 45 mm.; at 16°. 5 C. — 64 mm.
No. 1	15.0	59	10	183	
No. 1	15.0	59	11	184	
No. 1	15.0	59	20	185	At 16°. 0 C. — 45 mm.; at 17°. 0 C. — 90 mm.
No. 4	15.0	59	59	186	
No. 4	15.0	59	24	187	At 16° 0 C. — 45 mm.
No. 4	15.5	60	54	188	At 20 C. — 120 mm
No. 4	15.5	60	56	189	At 17 — 94 mm.

SUMMARY.

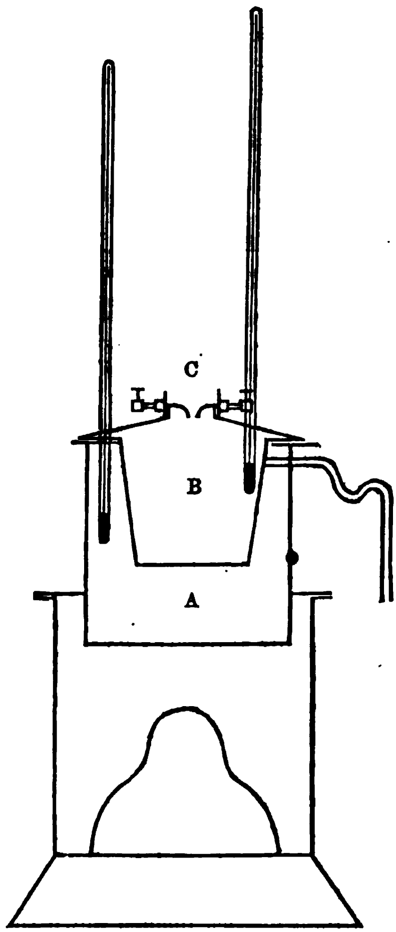
The aim of this apparatus is perhaps a good one, but the results of experiments with it are unsatisfactory. One of its worst faults is the absurdly small quantity (three cubic centimeters) of oil used for each experiment. Another difficulty is the constant fear that one of the many joints which it contains is leaking. A comparison of the tests obtained with this apparatus shows much discordance and the cause of this is not at all apparent since every care was taken that the

experiments should be successful. By comparing the number of millimeters of tension for every degree above fifteen Celsius, in the three oils used, we obtain the following results: No. 1 oil in experiment No. 182 showed in two readings an increase of 31 and 38 millimetres respectively for each degree rise; and in experiment No. 185 the same oil showed in two readings an increase of 25 and 45 millimetres respectively for the same rise of temperature. With No. 3 oil in experiment No. 179 two readings gave 14 and 30 millimeters respectively for every degree of rise in temperature; while in experiments Nos. 180 and 181 an increase of 33 and 37 millimeters respectively was obtained for every rise of one degree Celsius. In the same manner No. 4 oil gave in experiments Nos. 187, 188, and 189, an increase of 21, 14 and 25 millimeters respectively for every degree rise of Celsius. From these experiments it will be seen that the tensions of vapors obtained by this apparatus are too irregular and unreliable to make it a suitable instrument to be used to determiue the safety of kerosene oil.

XIII. PEASE'S ELECTRIC CLOSED TESTER.

This is the only closed tester with an electric flash that could be obtained for this investigation, and it is the last one patented in the United States. It consists of the usual water-bath and oil-cup, together with a spirit-lamp for heating the water-bath. In the oil-cup there are some modifications not found in other testers. In the first place there is an over-flow tube to determine a constant level of the oil while heating; and secondly, the cover of the oil-cup which slides back and forth in a horizontal direction is slightly convex and has a short tube in the centre which carries the wires to give the electric spark: thirdly, the thermometer is fitted to a hinged valve which closes a slot in the cover, and this valve is pressed down upon the cover by a small catch. The spark is obtained from any induction coil that will give one a quarter of an inch long.

Pease's Electric (Closed) Tester.



A. Water bath. B. Oil-cup. C. Spark wires.

XIII. *Pease's Electric Tester (Closed Test).*

OIL USED.	Density, degrees Be, 60° F.	Temperature.			Cubic centimeters in water bath.	Cubic centimeters in oil cup.	Rate of heating, degrees per min.	Flashing point.	Time of experiment.	Reference number.	Remarks.
		Water.	Room.	Oil.							
No. 3....	48	62	58	56	300	110	2.1	156	50	190	Figures in flash column mean fire-test.
No. 3....	do	57	70	65	do	do	1.9	140	45	191	Flash obtained by wave of hand.
No. 3....	do	55	70	65	do	do	1.5	122	43	192	Spark would not flash; at 110 with gas-jet obtained flash.
No. 1....	48	55	90	68	do	do	1.4	150	62	193	Figures in flash column mean fire-test; at 108 flash with gas-jet.
No. 1....	do	54	74	64	do	do	2.1	152	46	194	Same as 193; at 112 flash with gas-jet.
No. 1....	do	58	do	70	do	do	2.1	116	27	195	Flash tube closed with glass plate.
No. 1....	do	53	do	66	do	do	2.1	117	29	196	Same as 195.
No. 1....	do	56	75	65	do	do	1.9	116	32	197	Flash tube covered as 195, except ⅛ in.
No. 1....	do	do	do	66	do	do	2.0	117	31	198	Same as 197.
No. 4....	45	55	75	65	do	do	2.1	......	34	199	No flash obtained, except with jet.
No. 4....	do	53	do	62	do	do	1.7	92	22	200	Flash tube covered with plate.
No. 4....	do	55	do	66	do	do	1.7	92	19	201	Same as 200.
No. 4....	do	61	do	64	do	do	2.1	145	43	202	No flash; oil took fire.
No. 4....	do	56	do	66	do	do	3.0	99	15	205	Flashed by lifting thermometer valve.
No. 4....	do	58	do	64	do	do	2.9	97	17	206	Same as 205.

SUMMARY.

The experiments with this apparatus go to prove that from its construction it is little better than an open tester. The overflow tube to the oil-cup is a good modification and insures the same and a constant level for every experiment. But the cover of the oil-cup does not fit tightly enough and the opening in the centre is too large (¾ in.) Since the spark passes in the centre of the opening in the cover the vapors formed have a chance to get away around the sides of the opening, and very often a flash is not obtained until the oil itself takes fire. That the vapors do thus escape can be proved by flashing the oil with an eighth of an inch gas-jet pushed down the side of the flash-tube; and furthermore by covering the flash-tube with a small glass plate to hold the vapors a flash can be obtained at a much lower tempemperature. By simultaneously raising the valve of the thermometer opening when passing the spark, a flash can be obtained at about the same temperature, as the oil would flash upon an open tester. In fact the results obtained by this apparatus are not quite as good as those with Saybolt's Open Electric Tester, and like the latter it has the drawback of having a galvanic battery to be maintained.*

* Since the experiments with this tester were completed, the inventor has changed the opening that carries the spark wires, and made it much smaller, but I have not been able to make any experiments with this modified form. The devise appears to be a good one.

Petroleum tests required in various States and foreign countries.

STATE OR COUNTRY.	Flashing temperature.	Firing temperature.	Igniting temperature.	Date of law.	APPARATUS USED.
Canada	95				Abel's apparatus without change.
England	100			1879	Abel's apparatus, in which a flash at 73° F. — 100° on open tester.
France	95			1873	No apparatus mentioned.
Georgia		110		1870	Very rough test with saucer.
Illinois		150		1874	Tagliabue's Testers.
Indiana	120			1874	State Tester.
Iowa		100			
Japan		120		1881	
Kentucky		130			Standard instruments.
Louisiana	125				Tagliabue's or approved instruments.
Maine		120		1867	Tagliabue's or some other accurate instrument.
Maryland		110		1871	
Massachusetts	100	110		1869	Tagliabue's or other approved apparatus. Law under revision.
Michigan	120			1879	Special State apparatus.
Missouri		150		1879	
New Hampshire		120			Tagliabue's or approved appartus.
New York (City)	100				Tagliabue's Closed Tester.
Ohio	120			1880	Foster's Automatic Tester, or open tester described in law.
Pennsylvania		110			Tagliabue's or approved tester.
Vermont			110	1868	Tagliabue's Pyrometer or other equally accurate instrument.
Wisconsin		120		1880	State Tester or Tagliabue's Open cup.
Rhode Island	110			1871	Tagliabue's Tester.
Sweden	104			1875	Open vessel.
Germany (Berlin)			104	1867	Hannemann's Tester.

APPARATUS FOR TESTING INFLAMMABLE OILS PATENTED IN THE UNITED STATES.

PATENT No. 36,488. Apparatus for testing coal oil by J. Tagliabue, New York, Sept. 16, 1862. Claim for overflow holes on water bath, groove in oil cup to regulate height of oil, with glass wickholder, cork float and wire attached to side of oil cup. Essentially an open tester with floating flash-jet.

PATENT No. 36,826. Apparatus for testing coal oil by J. Tagliabue, New York, Sept. 1862. Claim for a closed apparatus with a chimney to ignite the vapors in. This is Tagliabue's well-known Pyrometer in its first form.

PATENT No. 35,184. Apparatus for testing coal oil and other mixed liquids, by H. J. Smith and W. Jones, Philadelphia, Pa., May 6, 1862. This is a partially closed tester with a flame over a cylindrical chimney, and the oil is heated directly in the oil cup without the use of a water bath.

PATENT No. 49,777. Petroleum tester by A. Millochau, Jersey City, N. J., Sept. 5, 1865. A rather shallow vessel with central section containing a wick which serves to heat and flash the oil. There is no water bath used.

PATENT No. 56,107. Carbon Oil Fire-tester, by G. E. Shaw, Pittsburgh, Pa., July 3, 1866. This is a partially closed tester, with a water-bath, two thermometers and a mechanical torch.

PATENT No. 104,798. Oil tester by P. H. Van der Weyde, New York, June 28, 1870. This appears to be a manometer apparatus for determining the vapor tension of inflammable oils.

PATENT No. 139,654. Apparatus for testing Hydrocarbon oils, by J. B. Blair, Philadelphia, Pa., June 3, 1873. Depends upon the unequal expansion of oils of different gravities.

PATENT No. 218,066. Electric oil tester by M. Saybolt, New York, July 27, 1879. An open tester with induction coil, bichromate battery and connections to give an electric spark at a given distance from surface of the oil.

PATENT No. 221,421. Kerosene oil tester by T. DeWitt Pinckney, Carmel, N. Y., Nov. 11, 1879. Appears to be a vapor tension apparatus; but description is very indefinite and drawing bad.

PATENT No. 226,187. Electric oil tester by F. S. Pease, Buffalo, N. Y., April 6, 1880. This is a combination apparatus of open and closed tester, with electric spark to flash the vapors.

LITERATURE RELATING TO THE TESTING AND SAFETY OF KEROSENE OIL.

In this list will be found the names of books, pamphlets, and periodical articles relating to this subject; and where practicable a brief synopsis of the contents is given. Where the same article is noticed in several journals the names of the latter are given, but the more easily accessible are given first.

1862.

Review of English Petroleum Act. In this act petroleum is conidered to be any products giving off vapors below 100° F.
Chemical News, vol. vi, p. 169:

1864.

Description of Parrish's Naphthometer. In this apparatus the vapors are made to pass into a chimney carrying a permanent flame. The oil is heated by a water bath; and the flame becomes extinguished when the flash occurs, 38° C (102 F.) considered the limit of flashing point.
Wagner's Jahresbericht, vol. x, p. 675; also *Freseniu's Zeitschrift* 1864, p. 228:

1865.

Kurtz experiments on Parrish's Naphthometer. Author finds that with small flames of the same size for flashing, and equal rates of heating of the water, he obtains good concordant results with this instruments. The flash-jet used was three-quarters of an inch high.
Wagner's Jahresbericht, vol. xi, p. 749:

1866.

Essai des Huiles Mineraies, M. M. Salleron et Urbain. Authors consider as *essence* all oils of less density than .735, and *heavy oils* all above .820; those intermediate are *burning oils*. 2500 litres of oil distilled and samples taken among those constituting burning oils gave the following vapor tensions:

Density at 15° C.	Tension in m.m. of water.
·812	0
·797	5
·788	15
·772	40
·762	85
·756	125

Mixing the samples from the distillation they had a density of ·800 at 15° C, and a vapor-tension of 64 m.m. of water.

Liquids inferior to ·735 density or essence of patroleum gave the following results:

Density at 15° C.	Tension in m.m. of water
·735	410
·695	930
·680	1185
·650	2110

Authors recommended 64 m.m. at 15° C as highest tension allowable.

Annales des Genie Civil, vol. v, 1866, p. 154:

Notice of Salleron-Urbain *vapor-tension apparatus.* Wagner says it is a modification of Pouillet's vapor-tension apparatus.

Wagner's Jahresbericht, vol. xii, p. 671:

T. T. Kuckla, of Vienna, describes an instrument for testing petroleum very much like Parrish's Naphthometer.

Wagner's Jahresbericht, vol. xii, p. 673:

H. Hager tests petroleum by distilling it in a bath of glycerine and dry crystallized calcic chloride at 125° C. From a good oil only a few drops of distillate come over.

Wagner's Jahresbericht, vol. xii, p. 674:

Also, *Fresenius's Zeitschrift,* 1866, p. 245:

J. Attfield "On the igniting point of petroleum." A paper read before the British Pharmaceutical society. Objects to the use of an open vessel in testing petroleum since it does not conform to the conditions of a lamp. Recommends a large test tube and agitation to obtain a flashing point; with ignition flame not closer than half an inch from the oil surface. With the author flashing point is equivalent to an igniting point.

Chemical News, vol. xiv, p. 257:

1868.

Dr. ROBERT PELKER "On the inflammability of petroleum and shale oils," gives the gravity of a number of petroleum products and the corresponding inflaming points. Also the same in regard to shale oils.
Dingler's Journal, vol. clxxxix, p. 61:

T. ALLEN of Rhode Island uses an open vessel and water bath to heat the oil for testing. 115° F. given as the lowest ignition temperature allowable.
Wagner's Jahresbericht, vol. xiv, p. 729:

R. PELKER "On the inflammability of the different products of Pennsylvania petroleum." *See above.*
Wagner's Jahresbericht, vol. xiv, p. 732.
Also, *Dingler's Journal*, vol. clxxxix, p. 61:

M. AUG. JUENESSE "On the regulation of the mineral oil industry," shows that the minimum temperature of ignition is 55°-56° C. against 37.5° C. the minimum allowed in England for American petroleum.
Annales du Genie Civil, July, 1868, p. 493.
Also, *Dingler's Journal*, vol. cxc, p. 498.
Also, *Wagner's Jahresbericht*, vol. xiv, p. 734:

"*Examination of petroleum and other mineral oils*" by NORMAN TATE, London, Greenwood. Description and criticism of the examination of petroleum under the English pretroleum act of 1868.

1869.

C. F. CHANDLER, PH. D. "Quality of the kerosene oil sold in New York city." Author gives composition of petroleum, remarks on the refining of petroleum, the quality of kerosene oil, and the fire test. In speaking of the last he says that 100° F. is too low a standard. He also gives tables showing the density, the vaporizing point and the burning point of the oils sold in New York city. There is also a table giving the percentage of naptha in a number of oils, and another on the temperature of burning lamps.
Report to the Metropolitan Board of Health, Jan. 11, 1869. *Supplementary report*, Jan. 21, 1869. *Abstract in American Gas-Light Journal*, Feb. 21, 1869.

J. ATTFIELD On "uniformity in taking igniting points," contains remarks on the petroleum act (1868).
Chemical News, vol. xix, p. 70:

M. GRANIER "On rendering petroleum and paraffine oils uninflammable, etc.," in *Les Mondes* says 110° F. is too low for the flashing point and recommends 180° F.
Chemical News, vol. xx, p. 250:

1870.

C. F. CHANDLER, PH. D. "Report on dangerous kerosene." Author gives a number of tables showing a number of oils that would not pass either flash or fire test, or fire test alone. Also an account of the fires from kerosene in New York and Brooklyn. And a summary of the laws relating to kerosene oil. Author also makes some remarks upon the testing of kerosene, the apparatus used, the influence of time and other conditions.

Fourth Annual Report, Metropolitan Board of Health, 1869. New York, 1870, p. 437.

Reprinted, 8vo. pamphlet, pp. 23, New York, 1870.

B. H. PAUL, "Mode of testing mineral oils used for lamps." Criticizes the English petroleum acts of 1862 and 1868. Condemns open vessels for testing. Also notes the influence of rates of heating upon the flashing point. Acts of 1862 and 1868 require a flashing point not below 100° F. Author says that the more freely the oil surface is exposed, the lower the burning point; the less freely the oil surface is exposed the lower the flashing point.

Chemical News, vol. xxi, p. 2:

F. CRACE CALVERT, "On the testing of petroleum spirit" shows by experiments that prolonged testing raises the flashing point, allowing volatile products chance of escape. Also claims that the flashing point is raised by agitation which expels the light vapors. Also that depth of thermometer makes a difference in the flashing point. Author recommends to heat the water bath ten degrees above the flashing point (previously found approximately), then remove the source of heat; then place the oil cup in the water bath, with thermometer half an inch below the oil surface, and use a small gas-jet to ignite the vapors.

Chemical News, vol. xxi, p. 85:

A. ERNECKE and HANNEMANN, of Berlin, describe an open tester and place the firing point at not less than 120° F.

Wagner's Jahresbericht, vol. xvi, p. 707:

K. LIST of Hagen criticizes the English petroleum act apparatus of 1870. From his experiments he believes that size of spirit-lamp flame, quantity of water in the water bath and depth of thermometer have much influence upon the flashing point; as also does the time of the experiment.

Wagner's Jahresbericht, vol. xvi, p. 708:

1871.

C. F. CHANDLER, PH. D. "Report on petroleum as an illuminator." Author gives history of petroleum, composition and refining of petroleum, and cheapest process for making a safe oil. Also table showing: 1. Consumption of oil in lamps; 2. Illuminating power; 3. Temperature of burning lamps; 4. Flashing points of a number of oils bought in New York city. He also gives an account of the various apparatus then used for testing the oil; and full accounts of the laws relating to kerosene in the United States and England.

First Annual Report of the Board of Health of the City of New York, 1871, p. 512. Reprinted 8vo pamphlet, pp. 110, New York, 1871.

Abstract in *American Chemist*, vol. II, pp. 409 and 446; vol. III, pp. 20 and 41.

Also, *Wagner's Jahresbericht*, vol. xviii, p. 841

Also, *Dingler's Journal*, vol ccv, p. 578.

Dr. VAN DER WEYDE on "New test for kerosene oils" describes a simple apparatus to collect and measure the vapors given off from petroleum, and thus obtain its relative safety.

Scientific American, Sept. 1871, p. 162:

H. BYASSON, vapor-tension apparatus for determining the safety of petroleum.

Compte-Rendu, Sept. 4, 1871.

Also, *Wagner's Jahresbericht*, vol. xvii, p. 859.

Also, *Chemical News*, vol. xxiv, p. 167:

K. VON WEISE gives relation of flash to fire test and shows they are not proportional. Author warms oil in a glass cylinder half filled with it, by means of a water bath. 100 c.c. of oil are used and there is no cover on the vessel. Ignition of the vapors is obtained with a small gas-jet.

Wagner's Jahresbericht, vol. xvii, p. 865.

1872.

Experiments with Hannemann's tester in the Chemical works of Eisenbuttel (Braunschweig), contains a table showing there is no relation between the flash and fire tests.

Wagner's Jahresbericht, vol. xviii, p. 846:

ED. MEUSEL describes an apparatus on the vapor tension principle, and says that it will show a half per cent of ligroine in petroleum.

Wagner's Jahresbericht, vol. xviii, p. 847:

1873.

GRANIER's apparatus consists of a small closed vessel with a small opening in the lid, and two-thirds filled with oil. It has a wick-tube in the centre of the small opening in the lid. The wick is lighted and heats the oil and is extinguished by the explosion from the flash.

Bull. d. l. Société d'Encouragement pour L'Industrie Nationale, No. 247, July, 1873.

Also, *Chemical News*, vol. xxviii, p. 10 :

Text of the *Decree of the French Government* in regard to the sale and storage of petroleum. The oil is considered dangerous if emitting an ignitable vapor below 35° C. Versailles, May 19, 1873.

Journal de Pharmacie et de Chemie, vol. xviii, p. 236:

1875.

Dr. H. VOHL, of Cologne, "On petroleum as an illuminator," etc., gives a table showing: 1. Specific gravity of petroleum products at 15° R (18.75 C.); 2. Temperature at which ignitable vapors arise ; 3. Percentage of essence (.74 s. g.) 4. Percentage of parafine oil (.85 s. g.); 5. Consumption of oil in grammes in wick 18 m.m wide and 2 m.m thick, with a suction distance of 8 centimetres. Also gives photometric determinations compared with gas. Recommends 27.5° C–28.75° C as a flashing point limit.

Dingler's Journal, vol. ccxvi, p. 47:

1876.

H. B. CORNWALL, on "Kerosene oil," gives experiments on the removal of naphtha from various oils which raised the flashing point 2.27° F. for every per cent removed, and shows that the addition of like quantities of naphtha removed lowers the flashing point in almost the same ratio. Also shows that the burning point is not a reliable test of safety, since low flash oils inflame when the lamps containing them are spilled ; and author gives a number of experiments proving this fact. Also shows that an oil flashing at 86° F. and burning at 107° F. can be made to flash at 100° F. by distilling off six or seven per cent of it.

Proceedings of American Chemical Society, June, 1876, vol. i, No. 1, p. 71.

R. S. MERRILL, on "Explosions and the methods of testing petroleum oil." Author describes the apparatus of S. S. Mann and says it is possible to show with it that kerosene oil is giving off imflammable

vapors ten to fifteen degrees below the flashing point and twenty-five to thirty degrees below the burning point.

Proceedings of the American Chemical Society, June, 1876, vol. i, No. 2, p. 115:

Report on Petroleum, by J. L. SMITH.

Author notices the open flash test and also Van der Weyde's vapor tension method.

Centennial Exhibition Reports Groups 3-7, Philadelphia, 1876.

1877.

Dr. CARL HEUMANN, "On heavy petroleum as an illuminator, etc.," gives a comparison of the distillation of different oils, their consumption in lamps, and light-giving power. Also some observations upon the danger of oil from easily inflammable vapors.

Dingler's Journal, vol. ccxxiv, p. p. 408 and 525:

Prof. F. A. ABEL'S "*Report to the Secretary of State for the Home Department on testing petroleum*," reports in favor of a closed vessel, and recommends a pendulum two feet long from the point of suspension to the centre of gravity, to beat three times while the flame is applied to flash the vapors from the oil. Prof. B. Redwood recommends metranome.

Chemical News, vol. xxxv, p. 73:

1879.

P. SCHWEITZER, PH. D. *Lecture on Petroleum*, delivered before a joint committee of the legislature of Missouri, Columbia, Mo. 1879.

Author mentions the dangers of low-grade oils, condemns the fire-test, and claims that the flash-test is the only reliable one.

H. HÖRLER, of Zurich. Review of Victor Meyer's work in Switzerland, "On the investigation and treatment of petroleum." Method of shaking oil with air after heating in a closed vessel, shows lower flashing point than in a partly closed tester. Size of shaking vessel and quantity of oil has no effect on the flashing-point. Author also gives table of experiments with burning lamps.

Dingler's Journal, vol. ccxxxiv, p. p. 52–61:

A. WAGNER, "Testing of petroleum and its danger from fire." Author uses the English, American and Berlin apparatus, (Ernecke

and Hannemann), and states that the American apparatus gives results 88–108 c above the English, which he prefers.

Wagner's Jahresbericht, vol. xxv, p. 1171:

M. ALBRECHT in Riga "On petroleum and its use as a lamp oil," Notes that in spite of the fact that petroleum should have a flashing point of 388 C (1008 F.) American petroleum is often found in commerce as low as 238 C. (748 F.)

Wagner's Jahresbericht, vol. xxv, p. 1173:

1880.

C. ENGLER describes a closed apparatus in which the electric spark is used to ignite the vapors, uses a double water bath and agitators to insure regular and uniform heating.

Die Chemische Industrie, No. 2, Feb. 1880:

R. HAAS describes a closed apparatus in which the oil is heated and shaken, while the ignition of the vapors is obtained by the electric spark.

Die Chemische Industrie, No. 4, April, 1880:

1881.

C. ENGLER and R. HAAS, on "The testing of petroleum for its safety."

Authors give a description of a number of experiments with typical apparatus. They reject all vapor-tension apparatus, as vapor tension and inflammability bear no relation to one another. Open testers are condemned as much too inexact. Of the closed testers they reject Tagliabue's, Sintenis and Parrish's naphthometer for faults in construction. Abel's apparatus is found to give too low results; while Bernstein's goes in the opposite direction. They claim that the most exact results come from the closed apparatus invented by themselves and in which the electric spark is used. Next to these they recommend Parrish's naphthometer as improved by Engler.

Fresenius's Zeitschrift, 1881, p. 1.

Also in *Sanitary Engineer*, New York, August, September, October, and November, 1881, abstracts by Dr. E. G. Love.

I cannot close this report without thanking Dr. E. G. Love and Mr. F. S. Pease for their courtesy in the loan of apparatus, etc. And to Prof. C. F. Chandler, I am especially indebted for his counsel, and the use of the suite of apparatus from the Chemical Museum of the School of Mines.

Chap. 292, Laws of 1882.

AN ACT to regulate the standard of illuminating oils and fluids for the better protection of life, health and property.

PASSED June 6, 1882; three-fifths being present.

SECTION 1. No person, company or corporation shall manufacture or have in this State, or deal in, keep, sell or give away, for illuminating or heating purposes in lamps or stoves within this State, oil or burning fluid, whether the same be composed wholly or in part of naphtha, coal oil, petroleum or products manufactured therefrom, or of other substances or materials, which shall emit an inflammable vapor which will flash at a temperature below one hundred degrees by the Fahrenheit thermometer, according to the instrument and methods approved by the State board of health of New York.

§ 2. No oil or burning fluid, whether composed wholly or in part of coal oil and petroleum or their products, or other substance or material, which will ignite at a temperature below three hundred degrees by the Fahrenheit thermometer, shall be burned in any lamp, vessel or other stationary fixture of any kind, or carried as freight, in any passenger or baggage car, or passenger boat moved by steam power in this State, or in any stage or street car drawn by horses. Exceptions as regards the transportation of coal oil, petroleum and its products are hereby made when the same is securely packed in barrels or matallic packages, and permission is hereby granted for its carriage in passenger boats moved by steam powei when there are no other public means of transportation. Any violation of this act shall be deemed a misdeameanor and subject the offending party or parties to a penalty not exceeding three hundred dollars, or imprisonment not exceeding six months, at the discretion of the court.

§ 3. It shall be the duty of the State board of health of New York to recommend and direct the nature of the test and instruments by which the illuminating oils, as hereinbefore described, shall be tested in accordance with this act. It shall be the duty of the public analysts who may now be employed by the State board of health, or who may be hereafter appointed, to test such samples of suspected illuminating oils or fluids as may be submitted to them under the rules to be adopted by the said board, for which service the said board shall provide reasonable compensation at the first quarterly meeting of the State board of health held after the passage of this act; it shall adopt such measures as may seem necessary to facilitate the enforcement of this act, and prepare rules and regulations with regard to the proper methods of collecting and examining suspected samples of illuminating oils, and the State board of health shall be authorized to expend, in addition to all sums already appropriated for said board, an amount not exceeding five thousand dollars for the purpose of carrying out the provisions of this act. And the sum of five thousand dollars is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the the purposes of this section provided.

§ 4. Naphtha and other light products of petroleum which will not stand the flash test required by this act may be used for illuminating or heating purposes only:—

In street lamps and open air receptacles apart from any building, factory or inhabitated house in which the vapor is burned.

In dwellings, factories or other places of business when vaporized in secure tanks or metallic generators made for that purpose in which the vapor so generated is used for lighting or heating.

For use in the manufacture of illuminating gas in gas manufactories, situated apart from dwellings and other buildings.

§ 5. It shall be the duty of all district-attorneys of the counties in this State to represent and prosecute in behalf of the people, within their respective counties, all cases of offenses arising under the provisions of this act.

§ 6. Nothing in this act shall be so construed as to interfere with the provisions of chapter seven hundred and forty-two of the laws of eighteen hundred and seventy-one, as regards the duties of the bureau of combustibles of the city of New York, or any other statutes not conflicting with this act, provided that nothing in this act shall be deemed to interfere with or supersede any regulation for the inspection and control of combustible materials in any city of this State made and established in pursuance of special or local laws or the charter of said city.

§ 7. All acts or parts of acts inconsistent with this act are hereby repealed.

§ 8. This act shall take effect sixty days after its passage.

NATURE OF THE TESTS AND INSTRUMENTS

BY WHICH

ILLUMINATING OILS SHALL BE TESTED.

Section 3, of chapter 292 of the Laws enacted by the last legislature, requires the State Board of Health of New York to recommend and direct the nature of the test and instruments by which the illuminating oils shall be tested.

Abstract of the law. SEC. 1. "No person, company or corporation shall manufacture or have in this State, or deal in, keep, sell or give away, for illuminating or heating purposes in lamps or stoves within this State, oil or burning fluid, whether the same be composed wholly or in part of naphtha, coal oil, petroleum or products manufactured therefrom, or of other substances or materials, which shall emit an inflammable vapor, which will flash at a temperature below one hundred degrees by the Fahrenheit thermometer, according to the instrument and methods approved by the State Board of Health of New York.

SEC. 2. "No oil or burning fluid, whether composed wholly or in part of coal oil and petroleum or their products, or other substance or material, which will ignite at a temperature below three hundred degrees by the Fahrenheit thermometer shall be burned in any lamp, vessel or stationary fixture of any kind, or carried as freight, in any passenger or baggage car, or passenger boat moved by steam power in this State, or in any stage or street car drawn by horses.

"It shall be the duty of the State Board of Health of New York to recommend and direct the nature of the test and instruments by which the illuminating oils, as hereinbefore described, shall be tested in accordance with this act. It shall be the duty of the public analysts who may now be employed by the State Board of Health, or who may be hereafter appointed, to test such samples of suspected illuminating oils or fluids as may be submitted to them under the rules to be adopted by the said board, for which service the said board shall provide reasonable compensation at the first quarterly meeting of the State Board of Health held after the passage of this act; it shall adopt such measures as may seem necessary to facilitate the enforcement of this act, and prepare rules and regulations with regard to the proper methods of collecting and examining suspected samples of illuminating oils."

At the quarterly meeting of the Board, held August 9th, it was *Resolved*, That for the purpose of carrying out the provisions of chapter 292 of the laws of 1882, the following rules be and hereby are adopted.

INSTRUMENTS AND TESTS.

(1.) The instruments to be used in testing oils which come under the provisions of section 1 of the law, shall be constructed as shown in the following diagram and description; *

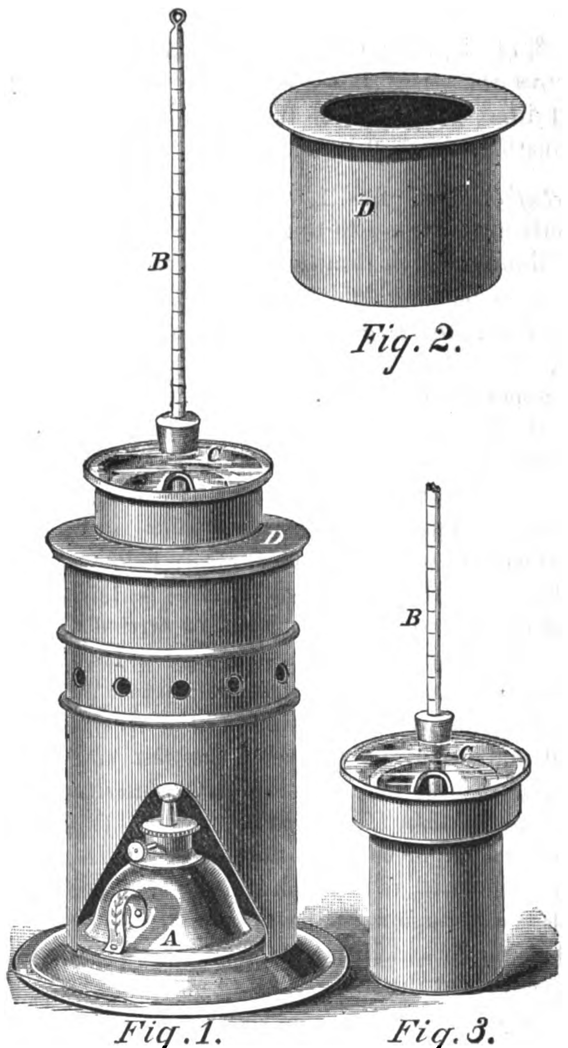


Fig. 2.

Fig. 1. *Fig. 3.*

***This instrument, in its original form, was devised and first employed by the Michigan State Board of Health; and a description of it will be found in its first annual report, 1873. The Wisconsin Board of Health afterward adopted the same instrument, and it is sometimes mentioned as the "Wisconsin tester." The analysts of this State, acting upon the suggestions of Mr. A. H. Elliott, have made some changes which, in their opinion, will render the testing easier and more certain.**

Fig. 1 represents the instrument entire. It consists of a sheet-copper stand 8¼ inches high, exclusive of the base, and 4¼ inches in diameter. On one side is an aperture 3¼ inches high, for introducing a small spirit-lamp, *A*, about 3 inches in height, or better, a small gas burner in place of the lamp when a supply of gas is at hand. The water bath, Fig. 2, is also of copper, and is 4¼ inches in height and 4 inches inside diameter. The opening in the top is 2⅞ inches in diameter. It is also provided with a ¼-inch flange which supports the bath in the cylindrical stand. The capacity of the bath is about 20 fluid ounces, this quantity being indicated by a mark on the inside. Fig. 3 represents the copper oil-holder. The lower section is 3⅜ inches high, and 2⅞ inches inside diameter. The upper part is 1 inch high and 3⅜ inches diameter, and serves as a vapor-chamber. The upper rim is provided with a small flange which serves to hold the glass cover in place. The oil holder contains about 10 fluid ounces, when filled to within one-eighth of an inch of the flange which joins the oil cup and the vapor-chamber. In order to prevent reflection from the otherwise bright surface of the metal, the oil-cup is blackened on the inside by forming a sulphide of copper, by means of sulphide of ammonium.

The cover, *C*, is of glass, and is 3⅜ inches in diameter; on one side is a circular opening, closed by a cork through which the thermometer, *B*, passes. In front of this is a second opening ⅜ of an inch deep and the same in width on the rim, through which the flashing jet is passed in testing. The substitution of a glass for a metal cover more readily enables the operator to note the exact point at which the flash occurs. A small gas jet, ¼ inch in length, furnishes the best means for igniting the vapor. Where gas cannot be had the flame from a small waxed twine answers very well.

(2.) The test shall be applied according to the following directions:

Remove the oil cup and fill the water-bath with cold water up to the mark on the inside. Replace the oil cup and pour in enough oil to fill it to within one-eighth of an inch of the flange joining the cup and the vapor-chamber above. Care must be taken that the oil does not flow over the flange. Remove all air bubbles with a piece of dry paper. Place the glass cover on the oil cup, and so adjust the themometer that its bulb shall be just covered by the oil.

If an alcohol lamp is employed for heating the water-bath, the wick should be carefully trimmed and adjusted to a small flame. A small Bunsen burner may be used in place of the lamp. The rate of heating should be about two degrees per minute, and in no case exceed three degrees.

As a flash torch, a small gas jet, ¼ inch in length, should be employed. When gas is not at hand employ a piece of waxed linen twine. The flame in this case, however, should be small.

When the temperature of the oil has reached 85° F., the testings should commence. To this end insert the torch into the opening in the cover, passing it in at such an angle as to well clear the cover, and to a distance about half way between the oil and the cover. The motion should be steady and uniform, rapid and without any pause. This should be repeated at every two degrees rise of the thermometer until the temperature has reached 95°, when the lamp should be removed and the testings should be made for each degree of temperature until 100° is reached. After this the lamp may be replaced if necessary and the testings continued for each two degrees.

The appearance of a slight bluish flame shows that the flashing point has been reached.

In every case note the temperature of the oil before introducing the torch. The flame of the torch must not come in contact with the oil.

The water-bath should be filled with cold water for each separate test, and the oil from a previous test carefully wiped from the oil cup.

(3.) The instrument to be used in testing oils which come under the provisions of section 2 of the law shall consist of the cylinder shown in Fig. 1 and the copper oil cup shown in Fig. 3, together with a copper collar for suspending the cup in the cylinder, and an adjustable support for holding the thermometer.

(4.) The test for ascertaing the igniting-point shall be conducted as follows: Fill the cup with the oil to be tested to within three-eighths of an inch of the flange joining the cup and the vapor chamber above. Care must be taken that the oil does not flow over the flange. Place the cup in the cylinder and adjust the thermometer so that its bulb shall be just covered by the oil. Place the lamp or gas burner under the oil cup. The rate of heating should not exceed 10° a minute below 250° F., nor exceed 5° a minute above this point. The testing flame described in the directions for ascertaining the flashing point should be used. It should be applied to the surface of the oil at every 5° rise in the thermometer, till the oil ignites.

(5.) The thermometers used for these tests should be compared, from time to time, with a standard thermometer, with special reference to the accuracy of the 100° and 300° marks.

COLLECTING AND EXAMINING SAMPLES.

(6.) The collection of samples shall be made under the direction of the sanitary commitee, by the inspector or the public analysts. The samples, properly marked, shall be placed in the hands of the public analysts for examination, and the results reported to the sanitary committee.

(7.) Whenever an accident shall occur from the explosion or ignition of any oil on the premises of a consumer, it shall be the duty of the inspector to at once secure, if possible, a sample of the oil, and submit the same to one of the public analysts for examination, and to procure such evidence as to the source of the oil and the nature of the accident as may be necessary for legal proceedings.

PROSECUTIONS.

(8.) It shall be the duty of the inspector, with the advice of the sanitary committee, to bring to the attention of the district attorneys all violations of the law which may be discovered, and to furnish the evidence necessary to the prosecution. It shall also be the duty of the public analysts to serve as witnesses when required to do so.

SUPERVISION.

The supervision of this work has been entrusted to the Sanitary Committee of this Board.

Samples of oil, and inquiries relating to the subject of rules and testing, should be addressed to the Chairman of this Committee, Prof. C. F. CHANDLER, Columbia College, Forty-ninth street and Madison avenue, New York.

The foregoing regulations and service having been ordered by this board, the law is to be faithfully respected and enforced.

EDWARD M. MOORE, *President.*
ELISHA HARRIS, *Secretary.*

OFFICE OF THE STATE BOARD OF HEALTH OF NEW YORK,
ALBANY, *August* 12, 1882.

REPORTS OF CHEMICAL ANALYSTS AND EXAMINERS, UNDER THE LAW FOR PREVENTING THE ADULTERATION OF FOOD AND DRUGS.

As provided and directed by the law known as, "An act to prevent the adulteration of food or drugs, chapter 407, passed June 8, 1881, the State Board of Health held a special meeting on the 23d of June to adopt such measures as seemed necessary to facilitate the enforcement of the act, and to prepare rules and regulations and appoint the necessary inspectors and analysts. The act is in the following words, namely:

"AN ACT to prevent the adulteration of food or drugs."

[Chapter 407, Laws of 1881.]

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. No person shall, within this State, manufacture, have, offer for sale, or sell any article of food or drugs which is adulterated within the meaning of this act, and any person violating this provision shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by fine not exceeding fifty dollars for the first offense, and not exceeding one hundred dollars for each subsequent offense.

§ 2. The term "food," as used in this act, shall include every article used for food or drink by man. The term "drug," as used in this act, shall include all medicines for internal and external use.

§ 3. An article shall be deemed to be adulterated within the meaning of this act—

a.—In the case of drugs.

1. If, when sold under or by a name recognized in the United States Pharmacopœia, it differs from the standard of strength, quality, or purity laid down therein.

2. If, when sold under or by a name not recognized in the United States Pharmacopœia, but which is found in some other pharmacopœia or other standard work on Materia Medica, it differs materially from the standard of strength, quality, or purity laid down in such work.

3. If its strength or purity fall below the professed standard under which it is sold.

b.— In the case of food or drink.

1. If any substance or substances has or have been mixed with it so as to reduce or lower or injuriously affect its quality or strength.

2. If any inferior or cheaper substance or substances have been substituted wholly or in part for the article.

3. If any valuable constitutent of the article has been wholly or in part abstracted.

4. If it be an imitation of, or be sold under the name of, another article.

5. If it consists wholly or in part of a deceased or decomposed, or putrid or rotten, animal or vegetable substance, whether manufactured or not, or, in the case of milk, if it is the produce of a diseased animal.

6. If it be colored, or coated, or polished, or powdered, whereby damage is concealed, or it is made to appear better than it really is, or of greater value.

7. If it contains any added poisonous ingredient, or any ingredient which may render such article injurious to the health of a person consuming it: Provided, that the State Board of Health may, with the approval of the governor, from time to time declare certain articles or preparations to be exempt from the provisions of this act: And provided further, that the provisions of this act shall not apply to mixtures or compounds recognized as ordinary articles of food, provided that the same are not injurious to health and that the articles are distinctly labelled as a mixture, stating the components of the mixture.

§ 4. It shall be the duty of the State Board of Health to prepare and publish from time to time, lists of the articles, mixtures or compounds declared to be exempt from the provisions of this act in accordance with the preceding section. The State Board of Health shall also from time to time fix the limits of variability permissible in any article of food or drug or compound, the standard of which is not established, by any national pharmacopœia.

§ 5. The State Board of Health shall take cognizance of the interests of the public health as it relates to the sale of food and drugs and the adulteration of the same, and make all necessary investigations and inquiries relating thereto. It shall also have the supervision of the appointment of public analysts and chemists, and upon its recommendation whenever it shall deem any such officers incompetent, the appointment of any and every such officer shall be revoked and be held to be void and of no effect. Within thirty days after the passage of this act, the State Board of Health shall meet and adopt such measures as may seem necessary to facilitate the enforcement of this act, and prepare rules and regulations with regard to the proper methods of collecting and examining articles of food or drugs, and for the appointment of the necessary inspectors and analysts; and the State Board of Health shall be authorized to expend, in addition to all sums already appropriated for said Board, an amount not exceeding ten thousand dollars for the purpose of carrying out the provisions of this act. And the sum of ten thousand dollars is hereby appropriated out of any moneys in the treasury, not otherwise appropriated, for the purposes in this section provided.

§ 6. Every person selling or offering or exposing any article of food or drugs for sale, or delivering any article to purchasers, shall be bound to serve or supply any public analyst or other agent of the State or local Board of Health appointed under this act, who shall apply to him for that purpose, and on his tendering the value of the same, with a sample sufficient for the purpose of analysis of any article which is included in this act, and which is in the possession of the person selling, under a penalty not exceeding fifty dollars for a first offense, and one hundred dollars for a second and subsequent offenses.

§ 7. Any violation of the provisions of this act shall be treated and punished as a misdemeanor; and whoever shall impede, obstruct, hinder, or otherwise prevent any analyst, inspector or prosecuting officer in the performance of his duty, shall be guilty of a misdemeanor, and shall be liable to indictment and punishment therefor.

§ 8. Any acts or parts of acts inconsistent with the provisions of this act are hereby repealed.

§ 9. All the regulations and declarations of the State Board of Health made under this act, from time to time and promulgated, shall be printed in the statutes at large.

§ 10. This act shall take effect at the expiration of ninety days after it shall become a law.

As directed by the Board at its meeting, June 23, the following circular of information and suggestion was issued:

CONCERNING THE LAW TO PREVENT ADULTERATION OF FOOD AND DRUGS.

OFFICE OF THE STATE BOARD OF HEALTH,
ALBANY, *June* 25, 1881.

The State Board of Health is required by this law to take cognizance of the interests of health as they relate to the sale of food and drugs, and the adulterations of the same. For this purpose it has undertaken the necessary investigations, and it now appeals to the people of the State for information and suggestions that may lead to the correction of wrong practices which the provisions of this law are designed to prevent.

Information and voluntary reports are specially desired concerning the following points:

In regard to Food-articles:—

1. Whatever is known or suspected of the adulteration of milk, condensed or uncondensed.
2. Whatever is known or suspected of adulterations and spurious materials sold as dairy butter.
3. Whatever is known or suspected of spurious or artificial liquids sold as wine.
4. Whatever spurious or adulterated substances are combined with or sold as sugar.
5. Whatever alkaline and other earthy substance is fraudulently sold as soda and its salts.
6. Whatever artificial mixtures are sold as baking powders, concerning which there is proof of injurious effects on health.
7. Whatever sugars, confections or other mixtures are known or believed to contain *terra alba*, or other earthy and mineral or metallic substances.
8. Whatever substances, mixtures or compounds recognized or sold as articles of food, drink, or medicine, are in, or to be placed in, the market for sale, and which are below the natural quality or strength, or which in the judgment of those concerned may be sold and used as articles of food, beverage or medicine, in accordance with the exemptions provided in sections 3 and 4 of chapter 407.

In regard to Drugs or Medicines:—

1. Whatever substances are known or suspected of any adulteration, or any depreciation from the *officinal* standards of the Materia Medica, and the Pharmacopœia, as designated in section 2, chapter 407, of the Laws of 1881.

2. Whenever a drug or compound, the composition of which is not established by a national pharmacopœia, shall be manufactured, offered and used in the State of New York, the standard ingredients of its composition and the range of variability from such standard or standards should be duly certified and officially filed at the office of the State Board of Health. There are medicinal compounds, of this kind, of such practical and extensive use, that their correct standards should be maintained by whoever makes and sells them.

This Board has appointed eight distinguished chemical analysts, located in various parts of the State, to serve under this law. Arrangements have been made for collecting the necessary samples of food-articles and drugs.

Whenever a citizen in this State desires to have samples of food or drugs tested, which are suspected of adulteration or other fault, he will please give notice by mail to Prof. Charles F. Chandler, chairman of the sanitary committee of this Board, under whose supervision the analyses and investigations are conducted, who will return his request, etc., concerning the same. The rules he will give in each case for procoring and sealing up samples for analysis should be followed.

Request.

All who are interested in promoting the welfare of life and health by guarding against adulterated and deleterious articles of food, beverages and medicine, will please carefully to observe and inquire concerning the illegal traffic in such articles; and this Board specially requests that whenever any person is cognizant of a case, or cases, in which there is, or seems to be, evidence of poisoning or injury from the use of any food-articles, beverages, drugs, condiments, and the accessories of food, information should be immediately given to the State Board of Health at its Albany office, and the reason for such opinion should be at once communicated, with the name of the informer. All such names and information will be so reserved, and the Board's action will be so directly responsible, that no inconvenience shall result to informants.

The State Board of Health desires the fact to be well understood by the public that this law originated as a national measure for the protection of the people, as recommended by the National Board of Health and National Board of Trade; and that in the State of New York its administration will be based upon effectual co-operation of the State Board of Health with the people and honest producers and tradesmen, and upon the faithfulness and skill of this Board's carefully selected chemical analysts.

On behalf of the State Board of Health,

ELISHA HARRIS, *Secretary.*

At its meeting in June this Board placed the supervision of all work connected with the Food and Drug Law under that subdivision of its members known as its Sanitary Committee; and on the 6th of July the chemists and examiners convened in the city of New York and entered upon organized work under the direction of said committee, of which Prof. Charles F. Chandler, of Columbia College, is chairman.

A definite rate of compensation was agreed upon and soon was accepted by the eight chemists thus engaged. Two expert inspectors were employed to gather samples for the use of the chemical analysts, and for ascertaining the facts relating to the substances used as foods, beverages and drugs. Subsequently a third expert inspector was employed.

E. H., *Secretary.*

REPORT OF THE SANITARY COMMITTEE OF THE STATE BOARD OF HEALTH ON THE ADULTERATION OF FOOD AND DRUGS.

By Charles F. Chandler, Ph. D., *Chairman.*

The Sanitary Committee makes the following report on the work performed during the past year in carrying out the provisions of chapter 407 of the Laws of 1881, entitled "An act to prevent the Adulteration of Food and Drugs;" passed May 28, 1881.

It was decided by the Board that the first step in carrying out the provisions of this act should be a careful examination of the food and drugs sold in different parts of the State in order to ascertain the nature and extent of the adulteration practiced; also to have carefully examined the methods of analysis in use for the detection of such adulterations, and to have presented for the use of those on whom the enforcement of the act would finally devolve the best literature on the subject.

For this purpose the different articles of food and drugs were divided into twelve groups, and these were assigned to chemists in different parts of the State for investigation and report.

The following list exhibits the classification:

Animal Food.

I. Milk fresh and condensed. Assigned to C. F. Chandler, Ph. D., Columbia College, New York.

II. Butter, dairy and artificial; cheese; lard; olive oil; and fruit essences. Assigned to G. C. Caldwell, Ph. D., Cornell University, Ithaca, N. Y.

III. Canned meats and animal foods, fresh, smoked, salted, canned; extracts and essences of meat and fish; gelatine and isinglass. Assigned to A. H. Chester, Ph. D., Hamilton College, Clinton, N. Y.

Vegetable Food.

IV. Cereals, and the products and accessories of flour and bread foods, wheat, rye, barley and rice, oatmeal, corn-meal, sago, tapioca

and leguminous preparations, special artificial foods for infants and invalids, baking powders, cream tartars, bicarbonate of soda, bicarbonate of ammonia, alum powders and the "alum question." Assigned to E. G. Love, Ph. D., New York.

V. Canned fruits and vegetables, preserves, vinegar, pickles, mustard, ginger, spices, antiseptics employed in preserving, glazing and enamel as affecting food articles. Assigned to S. A. Lattimore, Ph. D., University of Rochester, Rochester, N. Y.

VI. Sugars, syrups, molasses, glucose, confectionery, honey, and soda-water-syrups. Assigned to W. H. Pitt, M. D., Buffalo, N. Y.

VII. Tea, coffee, cocoa. Assigned to S. A. Lattimore, Ph. D., University of Rochester, Rochester, N. Y.

VIII. Wines, beers, spirits and cordials. Assigned to F. E. Englehardt, Ph. D., Syracuse, N. Y.

Drugs.

IX. Crude vegetable and animal drugs. Assigned to F. Hoffmann, Ph. D., New York.

X. Pharmaceutical chemicals and their preparations. Assigned to F. Hoffmann, Ph. D., New York.

XI. Gelatine and sugar-coated and compressed pills of quinine. Assigned to G. C. Caldwell, Ph. D., Cornell University, Ithaca, N. Y.

XII. Granular effervescent salts, fluid citrate of magnesia, seidlitz powders. Assigned to W. G. Tucker, M. D., College of Pharmacy. Albany, N. Y.

In addition to the chemists engaged in making these investigations it was found necessary to secure the services of two competent persons to gather the samples, and A. L. Colby, Ph. B., of New York, and T. Delap Smith, M. D., of Broadalbin, Fulton county, were appointed inspectors.

C. E. Munsell, Ph. B., of New York, was subsequently appointed an inspector, and to him was assigned the work of visiting the dairy regions, collecting information in regard to milk, and making analysis of samples.

Albert L. Colby, Ph. B., was requested to make a supplementary report on sugar.

Samples of food and drugs have been purchased from time to time and distributed among the analysts for examination, and the committee has the satisfaction of presenting herewith detailed reports embodying the results of this work.

Group I.

Milk, fresh and condensed, was referred toC. F. Chandler, Ph. D., with whom was afterwards associated C. E. Munsell, Ph. B.

The first part of the report is devoted to the composition of pure milk, and the most common frauds, which consist of watering, or skimming, or both. The frauds in milk differ from those of most other articles of food, in that pure milk varies in its composition in a very marked degree, making it impossible to establish a standard of purity, except by selecting the poorest milk produced by healthy cows for this purpose. As the frauds consist generally in increasing the amount of water, or diminishing the amount of fat (skimming) the

chemist can by his examination decide only whether the frauds practiced have reduced the original milk below the standard adopted.

The report then details the investigations by which the standard has been fixed.

The minimum specific gravity of 1.029, which has long been the standard in Europe, was confirmed by the examination of nearly one thousand cows in New York State, New Jersey and Connecticut. The maximum specific gravity was 1.0394 or 136 on the lactometer, the milk being from an Alderney cow. The lactometer employed, therefore, is the one in use in Europe on which 0 stands for the specific gravity, 1.000 or that of water, and 100 stands for that of 1.029 which is the specific gravity of the poorest normal milk from healthy cows. Thirty-eight analyses of pure milk were made by C. E. Munsell, and twelve more are quoted which were made by Elwyn Waller, Ph. D. The standard adopted by the English Society of Public Analysts and the New York City Board of Health is confirmed and adopted in this report. It is for the poorest milk from a healthy cow.

Fat	2.5
Solids, not fat	9.0
Water	88.5
	100.0

From the examination of commercial milk it appears that the sophistications of this article of food are extremely common. While a large proportion of the milk sold has been but moderately watered and skimmed and is still above the standard of the poorest milk, much of the milk has been *extended* and skimmed far below this standard. So openly are these frauds practiced that "Creameries" have been established in many localities, the names and locations of 73 such establishments being known to the writers, of which 63 are known to send skimmed milk to New York city, all of which is sold as whole (pure) milk on its arrival.

Special attention was paid to the use of brewers' grains as food for cows. It is found that when these grains are used in moderate proportions with good pasture or hay, etc., and the cows are properly cared for, no evil results occur either in the quality of the milk or the condition of the animals. The excessive use, however, of this food has a very bad effect on the cows.

The condensed milk, as served to customers in New York city, was carefully analyzed and found to be unobjectionable, and of good strength, except in one or two cases, where the small percentage of fat showed that the milk must have been partially skimmed before it was condensed.

Group II and XI.

To Professor G. C. Caldwell's care were submitted Group II, butter, etc.; and Group XI, gelatine and sugar-coated and compressed pills of quinine.

Forty samples of *butter* were examined: Of these, one appeared to be a mixture of butter and oleomargarine, one was adulterated with

water, five are considered suspicious, and 14 contain fatty matter other than genuine butter.

Of *cheese*, it appears that only one sample was submitted to examination which was said to produce sickness; the examination of this sample, however, failed to reveal any poisonous substance, and Prof. Caldwell concludes that the injurious action was probably due to an unknown organic substance resulting from an abnormal process of ripening.

Of *lard*, 28 samples were examined which varied greatly in color, texture and odor. Of these 15 contained no water, three had a little water while the rest contained water varying from 1 to 7.5 per cent. Aside from the question of adulteration, however, some of these could not be considered wholesome articles of food.

Olive oil.— Sixteen samples were examined, the tests being based upon the action of various chemical reagents on the oils. "To sum up the whole matter, while there may not be in the results of these tests, positive proofs of the presence of this or that foreign oil in particular there is fully sufficient proof of the adulteration of some kind."

Of the 16 samples, nine are considered as adulterated.

Besides the actual examinations, Prof. Caldwell's report contains a very valuable compilation of the best known methods of analysis of the different articles.

GROUP XI. Quinine in pills and compressed.

Prof. Caldwell's work in this direction was confined to the determination of the amount of quinine sulphate in the samples received without attempting to ascertain the extent to which other alkaloid of the bark are substituted for it to make up the deficiency where it exists.

Twenty-nine samples of quinine pills were examined, and it appears that in every case the amount of quinine sulphate was below that which it was professed the pill contained. Two grain pills were found to contain from 0.9 to 1.8 grains of the sulphate; the three grain pills contained from 1.7 to 2.8 grains, while the five grain pills contained from 2.4 to 4.7 grains.

GROUP III.

In the hands of Prof. A. H. Chester was placed Group III, canned meats and animal food.

After discussing the dangers and means of detection of trichinosis, in this report, meat extracts are considered, accompanied by 9 analyses of different meat extracts, being determinations of the water, the organic matter, ash, soluble albumin and alcoholic extract.

These extracts were found to be free of adulteration, unless the presence of gelatine and an undue amount of water can be so considered.

Then meat preserves are considered, under the heads of salting, smoking and canning.

Isinglass and gelatine are "indentical in composition and uses, but the isinglass is decidedly the finer, and therefore gelatine is often substituted for it in whole or part." Four samples were examined, two being sold as isinglass and two as gelatine, but all proved to be samples of gelatine.

Group IV.

Dr. Love, to whom were assigned bakers' chemicals, breadstuffs, etc., reports that of some 280 samples examined, only 35 were adulterated. The saleratus of commerce consists of the bicarbonate of soda instead of potash as was formerly the case. This salt as well as the bicarbonate of soda, sold under the name of baking soda, are generally free from adulteration. Cream of tartar, as sold by grocers, is adulterated to a great extent, the common adulterant being ground gypsum, the amount of which in several cases exceeds 50 per cent. Of 84 samples of baking powder examined, 58 per cent were what are known as cream of tartar powders, about 24 per cent were alum powders, while the remainder were tartaric acid and phosphate powders. Adulteration was reported in the case of eight powders.

In the examination of 117 samples of flour from various cereals, only eight were found to be adulterated, and of this number six were arrowroots. Ten samples of bread were found to be of satisfactory quality.

Dr. Love considers the "alum question" at some length and concludes that at the present time there is not sufficient evidence as to the injurious action on the animal system of alum as ordinarily used, to warrant its prohibition. The addition of alum to damaged flour, however, is condemned on the ground that it permits the unscrupulous to use an article often unfit for human food.

Groups V and VII.

Professor Lattimore had Groups V and VII in charge, Group V being canned fruits and vegetables; Group VII, tea, coffee, cocoa.

In Group V, 9 samples of canned fruit and the same number of canned vegetables were examined, and no indication of adulteration was found in any of them. The examination of the remainder of this group included the testing of vinegar, pickles and spices.

The vinegars, though all of inferior quality, were not adulterated, and of the pickles only one was found to contain any foreign ingredient, and that was alum.

The spices, however, of which 180 samples were submitted to investigation, show a great amount of adulteration.

Of the 180 samples, 112 were not the pure article, the percentage of adulteration being:

In Mustard	66.6
" Ginger	66.0
" Allspice	70.4
" Cinnamon	81.8
" Cassia	57.1
" Cloves	76.2
" Pepper, black	70.0
" " white	71.4
" " red	50.0
" Mace	50.0
" Nutmeg	40.0

The adulterating materials, however, all belong to the class claimed to be harmless, and in no instance has any poisonous substance been determined.

In Group VII there were examined, of *coffees*, 35 samples of unroasted; three samples of roasted unground; 21 samples of ground coffee and three samples of coffee-extract.

Among the 35 samples of unroasted coffee, there were found in five packages a few grains which had been slightly colored or faced, a minute quantity of blue pigment, apparently Prussian blue, adhering to the more prominent part of the bean. but the quantity was not sufficient to permit of satisfactory chemical tests. The roasted, unground coffee was found to be pure; of the 21 samples of ground coffee, however, 19 contained foreign substances, chiefly chicory and beans, and occasionally wheat or other grain coarsely ground. One sample consisted wholly of roasted hominy.

Teas.—Forty-three samples of green tea and 18 of black tea were submitted for examination.

Many of these were of most inferior quality, but no adulteration either vegetable or mineral was detected. Even the admixture of exhausted leaves cannot be positively asserted.

Chocolate and chicory. Five samples of the former and three of the latter were examined. Adulteration can, however, only be shown in one sample of chicory which was found to contain caramel.

In addition to the samples of food articles already mentioned, a considerable number of the so-called spice mixtures were examined.

These productions, bearing the marks of "P. D." pepper, "P. D." ginger, "P. D." cloves and so on, through the whole aromatic list; being nothing but imitations, with only so much flavoring of the genuine article as will make the goods sell, must be stamped as a fraud.

Group VI.

Including sugars, syrups, molasses, glucose, confectionery, honey and soda-water syrups, was assigned to W. H. Pitt. The report is chiefly devoted to the discussion of the manufacture of glucose and its properties. It is shown that glucose is a pure and wholesome article of food, being carefully manufactured and entirely free from objectionable impurities or admixtures.

Fifteen samples of commercial sugar were examined, but no adulterations were detected.

Of three samples of maple syrup examined, two were pure, one contained 35 per cent of artificial glucose.

Of three samples of honey, two were pure, one contained 50 per cent of artificial glucose.

In confectionery, glucose, terra alba and yellow chromate of lead were detected.

Albert L. Colby, Ph. B., was intrusted to prepare a supplementary report on sugar.

It is shown that the sugars now in the market are much cleaner and freer from the long list of impurities and adulterations reported to exist in former times, but that the falsification now practiced is the addition of glucose (grape-sugar) to the refined cane sugar.

116 samples of the various kinds of refined cane sugars sold in New York were examined. Of these 34 were classed as microscopically clean, 54 were very slightly contaminated with dust, 22 contained con-

siderable dirt, and 6 were very dirty. But in no case was there any intentional addition of insoluble mineral matter. Of these 33 were powdered sugar, all of which were found to be unadulterated.

The 49 samples of white sugars were all found to be free from adulteration with glucose. But of the 67 brown sugars examined, 4 were adulterated, and these to a large extent (from 22 to 33 per cent).

These adulterated sugars are sold in the wholesale market under certain trade names which signify to the purchaser their character. These are however usually disposed of in the retail trade as pure sugars.

As most of these "mixed sugars" are sent to the country they are rarely to be found in the hands of retail city grocers.

The methods of analysis are also given including a description of the apparatus used in determining the percentage of glucose added as an adulterant.

Appended to the report is a classified list of references to the literature of sugar.

Group VIII.

Dr. F. Engelhardt undertook Group VIII: Wines, beers, spirits and cordials. After discussing the most approved methods for the determination of the specific gravity, alcohol, extract, sugar, acids, ash, glycerine, etc. and after treating of the adulterants and methods of adulteration of liquors, Dr. Engelhardt details the results of chemical analyses.

Of 25 samples of brandy examined, 16 gave a distinct reaction for fusel oil, six contained only traces and three none whatever. In none could either sulphuric acid or chlorides be detected.

25 samples of whiskey were examined, and it appears evident that the addition of water and coloring matter is practiced more than any other adulteration. No free sulphuric acid was found in any of the samples. The alcohol varied from 28.9 to 60.3 per cent by volume.

25 samples of rum were examined, the percentage of alcohol by volume varied from 26.4 to 57.8. No objectionable additions were detected.

Groups IX and X.

Frederich Hoffman, Ph. D. was entrusted with Group X, pharmaceutical chemicals and their preparations, and Group XI, crude vegetable and animal drugs.

In testing medicinal chemicals, recourse was had to the most approved methods. In all, 317 samples were tested, only 11 of which were found to be either adulterated or deficient in quality.

In examining crude and powdered drugs, Dr. Hoffman relied upon their physical characteristics and their structure, and in some cases resorted to chemical tests.

Of the crude vegetable drugs, 232 samples were subjected to examination. Of these, 85 were either adulterated or did not in quality come up to the required standard.

Of powdered drugs, which offer in their examination much greater difficulties, 110 specimens were tested, embracing ipecac, jalap, orris and rhubarb roots and mustard seed, and of these, 46 were not of the required purity and strength.

In consideration of the fact that there are in the State of New York approximately, 2,800 drug stores where drugs and ready-made medicines are also sold, the number of specimens obtained for this examination presents too insignificant a figure upon which to form a correct inference or an average estimate of the quality and general character of drugs and medicines dispensed at present through our State.

From the tests however, made, medical chemicals are to be considered of "fair quality," less so in case of crude drugs. Powdered drugs "are to a great extent of unsatisfactory quality and questionable reliability."

Group XII.

To Prof. Willis G. Tucker, Ph. D., was assigned Group XII.

The granular effervescent salts, fluid citrate of magnesia, seidlitz powders.

Seidlitz powders and citrate of magnesia being the most important officinal preparations of this class, they claimed Dr. Tucker's special attention.

Seidlitz powders are produced by the mixing of two separate powders; the one 35 grains of tartaric acid, the other an intimate mixture of 40 grains of bicarbonate of sodium and 120 grains of the double tartaric of sodium and potassium or "Rochelle salt."

Seventy-two powders were examined, all of which were tested as to their weight, and it was found that there was considerable deviation from the prescribed standard.

A qualitative examination was then made of each powder. In every instance the tartaric acid was shown to be of good or fair quality, and the "seidlitz mixture," was only in three cases, found to be other than a mixture of Rochelle salts and soda, in one instance sugar was added, the second contained a considerable quantity of bicarbonate of soda, and in the third the soda was entirely wanting.

The quantitative determination of the bicarbonate of soda showed that there is considerable variation, evidently intentional, in the proportions of the ingredients employed.

The summary of the investigation leads to the conclusion that gross adulteration of this article is probably uncommon, but that without doubt, the powders are frequently, intentionally, manufactured of short weight, whereby the efficacy of these powders is materially lessened or even annulled.

The examination of fourteen samples of citrate of magnesium solution, showed six to be spurious, from which it would appear that the preparation sold under the name of "solution of citrate of magnesium" is often sophisticated.

Permissible Admixtures.

Paragraph 7 of section 3, and section 4, makes provision for certain harmless admixtures of food and drugs. The language is as follows:

Paragraph 7 of § 3. "Provided that the State Board of Health may with the approval of the governor, from time to time, declare certain articles or preparations to be exempt from the provisions of this act. And provided further, that the provisions of this act shall

not apply to mixtures or compounds recognized as ordinary articles of food, provided that the same are not injurious to health and that the articles are distinctly labeled as a mixture, stating the components of the mixture."

§ 4. It shall be the duty of the State Board of Health to prepare and publish, from time to time, lists of the articles, mixtures or compounds declared to be exempt from the provisions of this act in accordance with the preceding section. The State Board of Health shall also, from time to time, fix the limits of variability permissible in any article of food or drug, or compound, the standard of which is not established by any national pharmacopœia."

Numerous applications have been made to the Board by manufacturers and tradesmen, requesting the exact interpretation of these paragraphs, and also submitting various preparations for consideration, such for instance as coffee mixed with chicory, dried peas, etc.; syrup made chiefly of glucose from corn; mustard diluted with wheat or rice flour, etc., etc.

It has been deemed best not to take decisive action on any of these questions till after the reports on the different groups shall have been printed and carefully considered.

Literature.

In addition to the special literature relating to each topic of investigation which is mentioned in each of the reports, the committee appends to its report a general list of works relating to the analyses of food and drugs prepared by Albert L. Colby, Ph. B.

Respectfully submitted,
C. F. CHANDLER,
Chairman of the Sanitary Committee.

Group I.*

Milk Fresh and Condensed.

By C. F. Chandler, Ph. D., and C. E. Munsell, Ph. B.

Group II.

Butter — Dairy and Artificial; Cheese; Lard; Olive Oil, and Fruit Essences.

By G. C. Caldwell, Ph. D.

To Dr. C. F. Chandler,
Chairman of the Sanitary Committee:

Sir. — I submit herewith my report on the adulteration of articles of food and of drugs assigned to me:

In accordance with the request made at the first meeting of the bureau, I have collected and arranged so much of the literature of each subject as was accessible to me. I think that this collection is fairly complete so far as regards the journals; some recent German and many older monograph works on the adulteration of food I have been unable to consult; but having so full an account of the journalistic

---

*This report is printed after the reports on the other groups.

literature, I trust that I should not have found much additional matter of any importance in these works.

After this account of the literature of each subject of my division, I have given the results of my own work, and then, to avoid frequent repetitions of titles of articles and works, referred to, these are given together in the alphabetical order of the names of the authors; references to this list are made by small figures after each author's name.

Very truly yours,
G. C. CALDWELL, PH. D.

BUTTER.

Literature — According to the several authorities who have written on the subject, the substances named in the following list have been or are added to butter for fraudulent purposes: alum, borax, barium sulphate or heavy spar, chalk,. curd, fats cheaper than butter, flour, gypsum, lard, lead carbonate, lead chromate (yellow), potato flour, salt, sodium silicate or soluble glass, soapstone, starch, and water in excessive quantity. From carelessness in respect to the vessels in which it is put, it may contain copper or zinc; or (The Analyst II, 36) copper may be introduced by the practice, said to be not uncommon in England, of throwing some copper coins into the churn to make the butter come when it obstinately refuses to come in the usual manner.

Except as regards the cheaper fats, and water in excessive quantity, there is very little precise and reliable information as to the extent to which these various adulterations occur. I have met with only general statements by French, German and English writers, such as that they are common, or occasional, or as in the case of two or three, such as lead chromate for coloring the butter, rare. I shall limit my report on the adulteration of butter to the consideration of the use of cheaper fats and of water, partly because of the vastly greater importance, which at present attaches to the use of the former as compared with any other alleged adulterant, and partly because there was not sufficient time at my command to enter into an examination for other adulterants whose use is probably very rare in this country.

Cheaper fats as adulterants of butter — oleomargarine. — As far back as 1861, English chemists state that the adulteration of butter with cheaper fats is practiced in England on a large scale. *Hoskins* (67) writing at about that time says, that lard is the most common adulterant of butter in this country, and in one case that came under his own observation flour was added with the lard.

At present, oleomargarine occupies the most prominent position as an adulterant of butter. As is well known, this substance consists simply of the more fusible portion of the fat of beef animals; the fat is washed, cut up and melted at from 122° to 124° Fahr., the liquid fat is drawn off from the matters that settle to the bottom or collect on the surface, strained and kept at from 80° to 90° till the stearine and palmitine crystallize out to a large extent; these glycerides are separated from the still liquid portion by hydraulic pressure in a room kept at the same temperature; this liquid portion, which solidifies as it cools, constitutes the oleomargarine. To make it into butter it is churned with milk (80 pounds of milk to 500 of oil) and a little annatto, and run from the churn into a trough where it is suddenly chilled by thoroughly

mixing it with pounded ice, and is thereby prevented from crystallizing; it is then salted and worked. *V. Lang* (83) mentions the use of the extract of the milk glands of the cow to aid in emulsionizing the oil with the water of the milk, as still an essential feature in European practice in the manufacture of this butter, 110 pounds of the oil, 18 to 22 quarts of fresh milk and the same quantity of the extract being churned together. He mentions also the use of cumarin which is one of the substances that give the agreeable aroma to many grasses, and which is most abundant in the Tonka bean, for giving to this artificial butter that aroma which natural butter appears to derive from the food of cows, a very small quantity of the alcoholic solution of the substance or of the alcoholic extract of the bean itself being sufficient to flavor a large quantity of butter.

Concerning the statistics of the manufacture of oleomargarine and artificial butter.—In this State three firms are engaged in this manufacture, viz.: the Commercial Manufacturing Company, which has a factory in New York city and another in Albany; Schwarzschild & Sultzberger, with one factory in New York city and Stern & Metzger who have one factory in New York and another in Buffalo. The oil and butter are also manufactured in western cities. It was stated before the *New York Assembly Committee on Public Health* (43) that there are fifteen establishments in the United States engaged in this manufacture.

The Commercial Manufacturing Company produced from June, 1880 to May 1881, 5,189,297 lbs. of oleomargarine and 3,999,527 lbs. of oleomargarine butter, at their Albany branch they made 20,000 lbs. of oleomargarine per week. Schwarzschild & Sulzberger make from 230,000 to 250,000 lbs. of oleomargarine per week from the fat of their adjacent slaughter-houses, and at Buffalo 30,000 to 40,000 lbs a week. Stern & Metzger produce 150,000 lbs. per week.

These figures were obtained by Inspector Munsell from the firms themselves.

The oleomargarine is sold at about 16 cents a pound.

Concerning the *disposition of this oleomargarine*, it is both exported and sold in this country. From the testimony before the above mentioned *committee* (43) it appears that large quantities are sold for use in New York city and shipped to various parts of the State and to New England; it was stated that farmers buy it to mix with their butter. Abroad, according to *Lang*(83), it is highly esteemed for use on shipboard as a substitute for butter in cooking, since it keeps so well and is at the same time quite neutral in taste.

Concerning the *quality of the materials used in its manufacture* statements conflict. It is naturally claimed by the manufacturers that only the best part of the beef fat is used, and that a reasonable degree of cleanliness is maintained in all parts of the factory; others, in some cases undoubtedly quite as strongly biased in the opposite direction, say that all the refuse fat of the animal is used, clean and unclean alike, and even the fat of animals, including horses, that have died of disease; that alum and acids are used in the manufacture for cleansing the fat, and that the factories are filthy. No one can deny that in a manufacture of this kind there are such disagreeable possibilities, but many impartial observers who have visited the factories of

established reputation do not find such statements, as to uncleanness of the materials used or of the process of manufacture, to be justified, at least so far as factories of such a character are concerned.

Oleomargarine butter.—This oleomargarine is made into butter on a large scale by the Commercial Manufacturing Company and the oil is used by many firms in the city engaged in the cheese and butter business for making this artificial butter (Munsell) or perhaps for mixing with genuine butter. In the minority report of the *New York Assembly Committee on Public Health*, it is stated that the total product of oleomargarine butter in the State is 20,000,000 lbs. per annum, which is equal to one-fifth of the quantity of dairy butter made. Concerning the disposition of this artificial butter, it is exported and sold at home. The domestic trade, according to H. K. Thurber's testimony before this committee (43), has lately made up a much larger proportion of the whole than formerly; of the product of the Commercial Manufacturing Company in 1880–1 not over 10 per cent was exported, in the place of 40 or 50 per cent as formerly. The butter is consumed in New York city, New Jersey, Pennsylvania and in New England manufacturing towns, and much of it goes to the Southern States where it is stated to be sold under its own name. One witness before the Assembly Committee (43) affirmed that more artificial than natural butter is consumed in New York city.

It is sold at the same price as ordinary grades of butter; it was stated by many of the witnesses before the *New York Assembly committee* (43), that though it could well be afforded at a lower rate, to sell it so would only arouse suspicion and really injure the trade. It was also affirmed that it is sold in such a way as to imply that it is genuine butter, even if not stated to be such in so many words, and the consumer takes it supposing it to be such. But it appears that there are, or at least have been, places in the city where it is sold under its own name. It was stated that it is purchased largely by restaurants, boarding-house and hotel keepers.

As an imitation of genuine butter it is generally acknowledged to be so good that most people would not detect it, and that even experts may occasionally be deceived. It is more crumbly than genuine butter in cold weather, and to avoid this defect genuine butter is mixed with it — or, as in Holland, vegetable oils. Adulteration of genuine butter with from 40 to 60 per cent of oleomargarine is even more difficult of detection by the ordinary public than the entire substitution of oleomargarine butter for the genuine article; some even affirm that it cannot in some cases be distinguished from fancy or the so-called gilt-edged butter.

Lard as an adulterant of butter. It was affirmed by many witnesses before the *Assembly committee* (43), that lard is used in western cities for the adulteration of butter, and the product, containing only 25 to 50 per cent of genuine butter, is shipped to the east as well as consumed at home; that the process is kept secret, but that the trade here in the product under the name of "Lardine" is open and notorious; that thousands and thousands of packages of it reach the city, and that large quantities are shipped to Europe; that it is sold to retail dealers as oleomargarine butter, and by them to consumers as genuine butter; that fine soapstone powder is sometimes mixed with the lard; that the imitation is so good as to deceive anybody, and it is a

more dangerous counterfeit than oleomargarine butter, while other witnesses considered it as less so; that bakers prefer it to oleomargarine butter because softer. Inspector Munsell discovered one of these factories in New York city in the upper stories of a pork-packing establishment; there the lumps of the perfectly fresh hog fat are broken up, the tissue removed as far as possible, and the residue is melted by steam with about equal parts of inferior butter; 5,000 lbs. of larded butter are made per week at this establishment. A sample of the butter was examined by me for volatile fatty acids, and with the microscope (No. 2017, p. 527). One witness before the committee above cited, gave it as his opinion that all the firms manufacturing oleomargarine use some lard. It was stated in April, 1880, that lard butter was sold in New York at twenty cents a pound; that in character it was ranked as "fair, about on a par with ordinary dairy lines, but grain too fine, and no quality."

Mr. Burrill (of Whitman & Burrill, Little Falls), states in a letter to Mr. Munsell, that by way of experiment only, they have made a few pounds of butter from their emulsion of lard (see p.), or artificial cream as they choose to call it, by setting it aside for twenty-four hours to become acid, as cream usually is for churning, and then churning it in the usual manner, and also by "setting" a mixture of the artificial cream and new milk for the cream to rise in the usual manner; both the natural and artificial cream came up together, and this mixture when churned gave a product which it was very difficult to distinguish from the best creamery products, although only one-fourth to one-half of it was genuine butter. He states, however, that the artificial cream is not used in this way at any of the creameries where it is made, but that all of it goes into the cheese; only genuine butter is made at the lard cheese factories.

Concerning *adulteration of butter with vegetable oils*, it was affirmed in the minority report of the Assembly committee that the adulteration of butter with lard and *cotton-seed oil* was known to be extensive. In Holland, according to *Griessmayer* (52), an imitation of butter is made by simply mixing tallow and olive oil. It is affirmed that in Holland rape oil is purified by heating it with starch to 300° C. and above, till a golden yellow, agreeably tasting oil is obtained, which mixed with tallow gives a butter-like product; but *Lang* (83), says that in repeated attempts to make this oil, he always gets a product that is very offensive both in odor and taste, which could not possibly be used for making an imitation of butter.

The Question of Adulteration.

Is the use of these cheaper fats for butter an *adulteration*, since butter is mostly nothing but fats of identically the same character?

In substituting a cheaper article for a dearer one, and selling it for the dearer one, the law is violated. Whether it is also violated by the addition of an unwholesome substance to a common and necessary article of food appears to be still an open question. Leaving for the moment the affirmations out of consideration, that have been made as to the presence of unwholesome matters in the oleomargarine itself, is pure oleomargarine unwholesome or not? In 1879 the *English Local Government Board*, which has charge of the detection and ex-

posure of adulterations of food, declared (*Mark Lane Express*, August 25, 1879), that it could see no reason against the use of oleomargarine, provided that it be invariably sold under a distinctive name, and not fraudulently substituted for genuine butter. According to earlier French official reports, artificial butter was recognized as a perfectly wholesome article of food (*Encyclopædia Britannica*, Article, *Butter*). But later, in a *Report of a Commission* appointed by the French Academy of Medicine, the opinion is expressed that its effect on the health is not good, because of its larger proportion of glycerides of the insoluble fatty acids, and the greater difficulty with which it is emulsionized in the digestive organs (*Wagner's Jahresbericht*, 1881, p. 711; *Country Gentlemen*, 1880, pp. 392, 449). But no positive evidence of the soundness of the opinion appears to be given.*

But if certain assertions which have been made public, mostly in the newspapers, as to the character of the oleomargarine itself shall meet with any wide confirmation, the use of oleomargarine in or for butter is dangerous to health because of the impurities that it contains. *Mr. John Michell* (94) has found portions of tissue and muscle, and cells and forms of a suspicious character in oleomargarine. *Mr. Thomas Taylor* (127), microscopist of the Department of Agriculture at Washington, with a power of 250 diameters observed in a sample of oleomargarine animal tissue more or less over the whole field, and in another instance crystals of magnesium urate, showing the fat used to have been impure, but in a communication to *H. A. Mott* (96) he appears to take a different view of the matter, and to regard oleomargarine butter as harmless. *Dr. R. U. Piper* (108) states that he found in a sample of oleomargarine butter, received from a respectable eating house in Chicago, shreds of animal tissue, spores, forms frequently seen in foul water, other forms moving actively across the field, and various forms of fungi such as may be seen in putrifying milk; he also states in another western paper (107) that he has seen eggs resembling those of tape worms. It is often affirmed that the fat of diseased animals is used for the preparation of oleomargarine, and, as having an important bearing in respect to this assertion, *Rev. W. H. Dallinger* (94) is quoted as stating that the whole "septic series of organisms require a temperature of 140° Fahr. to kill the fully developed forms," and the "germs of this series require at least 212° to 235° Fahr. for their destruction in a fluid," and that "the temperature reached in the manufacture of oleomargarine is perfectly innocuous to such organisms of this kind as refuse fats may contain," and that "the eggs of nematoda are practically uninjured by a temperature of 120° Fahr."

As an offset to these affirmations we have the statements of other microscopists, such as *Prof. J. W. S. Arnold* (6) of the University of New York, that no such objects are found in good oleomargarine, and the often repeated assertion that only clean fat of healthy animals is used for its manufacture. *H. A. Mott* (96) shows what precautions are taken in this respect, and brings together in his pamphlet facts and opinions in reply to those who see so much danger to the public health lurking in this substance. But it will require much negative testimony, based on the results of careful and perfectly impartial observa-

---

* See p. 531 for some considerations on the wholesomeness of lard.

tion, to satisfactorily rebut in the judgment of the people such positive testimony as we have noticed; this statement may be made and accepted without expressing any opinion, one way or the other, on the reliability of this positive testimony as to what has actually been seen with the aid of the miscroscope, by persons claiming to be acquainted with the use of that instrument. The results of my own examination of such samples of butter as have been sent to me by the inspectors, and have been found by chemical tests to be oleomargarine butter, may furnish some contribution to the solution of the question as to the occurrence of these objects.

Water as an adulterant.—Without fraudulent intent butter may contain as much as 20 per cent of water, although it does not ordinarily, when of fair quality, contain more than half as much. *Hassall, Parkes, Calvert,* and *Angell* and *Hehner* (5) give from 5 to 10 per cent as the ordinary limits. *Wanklyn* (5) found in 50 samples of London Workhouse butter 8.6 to 23.7 per cent. *Fleischmann* (46) says that, according to all statements which he can find in the literature of the subject, pure, unadulterated butter never contains over 18 per cent of water, nor less than 80 per cent of fat, and from 2 to 6 per cent of other matters; and that on the average it contains when salted, 12 per cent of water, 83.5 per cent of fat, and 4.5 per cent of salt and other matter. Neverthelesss, he says, butter can be loaded with from 20 to 50 per cent of water by kneading it in, or by kneading fresh butter with salt water, or by stirring the butter vigorously with boiling water till the water cools down; its appearance when so charged with water may not be essentially changed, and its taste may be fair. *Hassall* (56) says that water is one of the most frequent adulterations of inferior butters, salt being added at the same time so that more water will be taken up; that 50 per cent of water may be incorporated into the butter by melting it and stirring it with salt and water. *Angell* and *Hehner* (5) found 42.3 per cent in one instance. *Lang* (83) shows that oleomargarine butter usually contains less water than natural butter, and more fat, which he considers as an item in its favor. *Johanson* (71) gives instances where butter contained from 40 to 49 per cent of water, incorporated by adding luke-warm water to the melted butter and then stirring the whole together in a pail surrounded with snow till the mass became solid; he states that great care has to be taken however, to keep such butter cold till it is sold, for in a warm room the water separates out and the butter floats in it. In one case in England (The Analyst, 4, 16), the seller of a sample of butter containing 23 per cent of water was convicted of fraud. It will be seen from the results of my examination of butters, that this method of adulteration is not unknown in this country.

METHODS OF EXAMINATION OF BUTTER.

Most of the recent literature on the examination of butter for the detection of adulteration refers to the detection of oleomargarine or other fats. For convenience of reference I have classified the methods of examination as follows:

A. Tests by specific gravity.
B. Tests by melting point.
C. Tests by the microscope.

D. Brief qualitative tests.
E. Partial quantitative analysis.

A. *The specific gravity test.* This is applied to the pure butter fat, freed from water, casein and salts by filtering it while melted. The usefulness of the test depends on the fact that fats generally used for the adulteration of butter have a lower specific gravity than that of pure butter fat; while the specific gravity of the latter ranges from 0.865 to 0.868 at 100° C., beef and mutton fat have a specific gravity of 0.860, and lard 0.861. Some analysts take the specific gravity of the butter at temperature below its melting point, and others above, treating it as a liquid, others at a little below 100° C. and others at 100° C. or the boiling point of water.

Stillwell (125) gives the specific gravity of several fats. *Blythe* (15) gives a method for determining the specific gravity of butter as a solid. *Pfeifer* (106) describes a very convenient method for taking the specific gravity at 100° C. with a Mohr–Westphal balance. *Estcourt* (41) gives a method for taking the specific gravity at 98° C., which is the constant temperature taken by paraffine in a cylinder surrounded by boiling water. *Bell* (12) describes his method of determining the specific gravity by the piknometer, and gives results of the determinations of the specific gravity of 117 samples of genuine butter, together with their fusing points and proximate composition. *E. Kœnig* (76) gives a method for the use of the areometer at 100° C. *Ambuhl* (2) modifies Koenig's process slightly. *A. Mayer* (90) also uses an areometer at 100°, gives a new form of apparatus for the more accurate reading of the instrument, and thinks the test is very reliable. *Leune and Harbulot* (86) describe a margarimeter in which an areometer is used at 100°. *Jones* (72) affirms that if butter fat is kept for a considerable time at 100° or even at 50° C. its specific gravity increases sensibly. *Hager* (53) gets the fat into rounded globules by pouring it, while melted, dropwise into cold alcohol, and then takes the specific gravity of a dilute alcohol or glycerine, in which these globules will remain stationary. *Wigner* (135) uses a glass bulb which will just sink in pure butter fat at a certain temperature; if this bulb sinks in a sample of butter at a lower temperature the sample is to be regarded as suspicious. Several analysts (The Analyst, 1, 1877, p. 26), agree that the specific gravity test by any method has comparatively little value.

The specific gravity test is not mentioned at all in many recent monograph works. *Dietzsch, Husson, Hassall, Liebermann* and *Medicus* do not allude to it. *Blythe* (14) describes his own and Wigner's methods. *Griessmayer* (52) and *Elsner* (39) describe only Koenig's method, and the latter praises it highly.

It may be concluded that the test is not one upon which much reliance can be placed.

B. *The fusing point test.* This test depends for its usefulness on the fact that the melting point of butter is lower than that of many other fats with which it is commonly adulterated; it must, like the specific gravity test, be applied to the pure fats of the butter, freed by melting and hot filtration from other matters.

The fusing point of genuine butter fat ranges, according to various authorities, from 28° to 37° C.

Wimmel (136) gives the melting and solidifying and sinking weight points of several fats. He mentions as having a lower melting point than butter, a substance used for its adulteration, known as Maugosteen oil, Kokum butter or butterine,obtained from the seeds of Garcinia Indica, which melts at 31.3°C. while he gives the fusing point of butter fat as 35.8°. *Dietzsch* (29) gives the fusing point of genuine butter at 36° and its solidifying point at 23 deg., and of French oleomargarine at 27° and 25° but mentions no method of determination. *Elsner* (39) gives 31.5° for the fusing point, and 20° for the solidifying point of butter, and for artificial butter 28° and 20° for these two points, but gives no method of determination. *Fleischmann* (46) gives 36° C. for the fusing point and 23° for the solidifying point of pure butter, but he places little reliance on this test for adulteration with other fats, since it would be so easy to make mixtures of cheaper fats having the same melting point. *Griessmayer* does not mention the test. *Hassall* (56) describes a method of making the test which consists in noting the temperature at which a small bulb, lighter than the fat and temporarily anchored at the bottom of the tube, rises when released by the melting of the fat above it; by this contrivance he gets the melting point of butter fat to be from 32.8° to 34.9°, and of all other natural animal fats from 38° to 51°. *Husson* (68) gives 28° for the melting point of butter, and discusses the unsatisfactory character of the test, quoting "Chevallier and Baudrimont's Dictionnaire des Falsifications," and other authorities to that effect. Butter fat according to him melts at 31° to 32.5°. He also discusses the methods of determining the melting points of fats. *Ruedorff* (118) discusses the same subject and criticises Wimmel. *Moser* (95) finds the fusing points of two samples of artificial butter to be below, instead of above that of genuine butter, namely 27° and 31.7°. *Wuenzel* (139) gives the melting points of pure butter and of adulterated mixtures with other fats. *Bell* (12) finds in the case of 117 samples of genuine butter that the melting point ranges from 29.5° to 35°. C. *Roster* (115) describes a method for the determination of the melting point of organic bodies. *A writer* in Les Mondes (Chem. News, 43, 1880, p. 77), states that by adding lard to oleomargarine its melting point can be lowered, so that this test will not betray adulteration of butter with such a mixture. *Duffy* (35) describes allotropic modifications of fats with different melting points, and (34) shows the difficulties to be met with in the testing of butter by the melting point. *Tripe* (130) and also *Heisch* (63) describe methods for the determination of the fusing point by the use of a capillary tube to take up the fat, and *Kellner* (75) modifies their method. *Angell* (4) determines the melting point by noting the temperature at which a weight, consisting of a small pear shaped glass bulb, occupying about one cubic centimetre in volume and weighing with some mercury contained in it very nearly 3.4 grams, sinks into the fat when the temperature is slowly raised. In the case of 24 samples of genuine butter examined, this point ranged from 34.3° to 36.6° C. If foreign fats are present the sinking point varies with the proportion of the adulterant present. *Redwood* (110) notes the temperature at which a globule of the fat on mercury fuses and spreads over the surface of the metal in which the bulb of the thermometer is immersed. *Brown* (18) gives the behavior with heat of several genuine butters, other fats and mixtures of butter with them.

In monograph works, *Blythe* (14) describes the use of the capillary tube. He shows what appears plainly enough from the figures given above, that authorities do not agree as to what the fusing point is, and as to the effect of admixture of other fats. *Liebermann* and *Medicus* make no mention of the test.

It is clear that each one who would test butter for adulteration by the determination of the fusing point should fix upon his own standard of comparison by many tests of his own of genuine butter and its adulterants and of mixtures of them together.

C. Microscopic tests.—These may be applied for the detection of starch or flour and of foreign fats; in the latter case the test sometimes depends upon the fact that as these fats have, at least in some cases, been melted in the process of their manufacture, their solid particles may be supposed to show a crystalline structure under the microscope, which can be brought out more plainly with the aid of a polarizer.

Horsley (65) distinguished butter and tallow from lard by the appearance under the microscope of the residues left by the spontaneous evaporation of a benzol (petroleum ether ?) solution of the fat, after moistening the residues with ammonia. *Lechartier* (84) describes the test, but the editor of the journal states by way of comment, that in one case butter a year old and guaranteed to be genuine was seen by him to contain crystals. *Mylius* (100) describes the appearance in polarized light of fats that have been melted, but *Frisenius* (49) calls to mind Hassall's statement that crystals may appear in genuine butter that has been kept for a long time, and that they are often met with even in cream. *J. C. Brown* (18) gives the results of an examination of butter and several other fats under the microscope with polarized light. The *English public analysts* (40) discuss the test, and conclude that little can be accomplished with it. *T. Taylor* (128) used the microscope and polarized light for distinguishing natural from artificial butter. *Storch* (126) shows that natural butter is composed of fat globules and droplets of butter serum, and that with a magnifying power of 300 to 400 diameters genuine butter presents the appearance of a crowded mass of these droplets and globules, while where foreign fats are kneaded in continuous plates of fat are to be seen here and there displacing the droplets and globules, and that oleomargarine butter contains but a few and unusually large droplets of serum; these observations are illustrated by figures in the original article.

In monograph works, *Blythe* (14) recommends the use of the microscope with the polarizer. *Dietzsch* (29) does not mention the test, and *Elsner* (39) describes it only for starchy substances. *Griessmayer* (52) quotes Mylius. *Husson* (69) describes the test with polarized light, but shows that the crystalline appearance may be presented where the butter had previously been melted on the outside in very warm weather, or when, as is sometimes done in Devonshire, the cream is scalded, or boiling water is poured into the churn before the cream is put in. Scalded cream butter has been made also in this country, but is now rarely made, as we are informed. *Liebermann* (86) does not mention the miscroscopic test, and *Medicus* (91) speaks of it only as applied to the detection of starchy adulterations. *Angell and Hehner* (5) say that the occurrence of crystals in butter is ground for suspicion,

but not evidence of adulteration, nor is their absence evidence of freedom from adulteration. *Mott* (93) shows that by the rapid chilling of the churned oleomargarine it is prevented from crystallizing, so that the regular oleomargarine butter,as made in this country,shows under the microscope fat globules like ordinary butter. *Taylor* (96) seems to grant this.

It is plain therefore that little dependence can be placed on any microscopic test of the genuineness of butter, at least so far as the observation of crystalline forms of foreign fats is concerned, for neither does the absence of such forms prove that the butter does not contain oleomargarine, nor does their presence prove the adulteration.

Brief-qualitative tests for adulteration with foreign fats. — Under this head I include such tests, simple in respect to their manipulation and in respect to the apparatus required, as can be made under ordinary circumstances, and with inexpensive means and appliances. *Horsley* (66) and *Ballard* (9), treat the filtered fat with ether at 185° C., when butter fat dissolves readily, while lard,tallow and the like do not dissolve so easily; and by the addition of methylic alcohol to the solution butter fat is not precipitated, while the others are. *Hoorn* (64) takes up the fat of the butter with petroleum ether of sp. gr., 0.69, and boiling point 80° to 110°, evaporates the solution completely, dissolves one gram of the residue in seven cc. of ether, corks the flask and lets it stand an hour in water at 10° to 15° C.; normal butter fat remains in solution, while veal fat, tallow and lard are deposited if present in larger proportions than ten per cent. *J. C. Brown* (18) describes the behavior of several fats with ether, and gives a method for detecting foreign fats by the larger deposit from an etherial solution under certain conditions, of stearine from fats containing more of it than butter contains. *Angell and Hehner* (5) pronounce the method to be far from satisfactory.

Gatehouse (50) gives a method based on the insolubility of potassium stearate in water when produced at from 205° to 216° C. The carefully washed fat is saponified by heating it to that temperature with solid potassium hydrate ; on boiling the cooled soap with successive portions of distilled water till 200 cc. have been used, an opalescent liquid is obtained with genuine butter fat, but a decidedly opaque one if lard or any other fat containing much stearine has been added.

Lechartier (84) states that when genuine butter is heated to fusion it passes at once to a clear yellow oil, while artificial butter liquefies gradually, forming at first a whitish emulsion. *Hager* (53) sets the oil on fire in a lampwick, after a few moments extinguishes the flame, and notes the odor of the smoke from the glowing wick; in the case of oleomargarine butter there is a very decided reminder of a smoking tallow candle wick. *Donny* (31) heats the butter in a test tube to 150° or 160° C. Artificial butter foams but little, and the ebullition is violent and irregular, with sudden spurts of effervescence; the particles of casein become brown and attach themselves in clots to the sides of the tube; genuine butter gives with similar treatment much less foam and less violent action, and the brown particles remain suspended in the liquid, giving a brown color to the whole, as in making a butter sauce. *De Smedt* dissolves the butter fat in ether, pours the solution off from the insoluble matters into a saucer and leaves it till the ether has evaporated; the residue from artificial butter has more or less of

a tallowy odor, especially if gently heated, which the residue from genuine butter does not emit; the odor of its residue is more like that of butter itself. *Hager* (53) distils a mixture of the filtered melted fat of the butter with two parts of a mixture of sulphuric acid and alcohol, and observes the odor of butyric ether of the distillate which in the case of genuine butter is of course very marked.

Crook (27) treats the filtered fat with a solution of carbolic acid; butter gives a clear solution, while beef, mutton or swine fat gives two layers, the upper one of which becomes turbid on cooling. *Filsinger* (44) mixes five grams of the melted butter fat with 15 cc. of ether, sp. gr., 0.725, and another like quantity with 15 cc. of a mixture of four parts ether and one part of alcohol by volume, and keeps these mixtures at 18° to 19° C. for 12 hours. Pure butter fat solution remains all this time perfectly clear, while if other fats are present the liquids become turbid; the author thinks that ten per cent of adulterations with foreign fats can be detected in this way.

In recent monograph works, *Blythe* (14) mentions no test coming under this head not already given above. *Dietzsch* (29) describes the following: he mixes three volumes of concentrated sulphuric acid with two volumes of the clear butter fat obtained by filtration, or by allowing the butter to stand for a considerable time in the melted condition when all the matters not fat will settle to the bottom or collect in a crust on the surface, and then pouring off the clear fat; when thus treated with acid genuine butter fat does not become much heated, while it changes to yellowish red and then to a uniform brown, translucent mass; if tallow or any other animal fat is present the mixture becomes very hot and black, and opaque; a writer in The Analyst, who finds this test described in the Pharmaceutische Centralhalle is disposed to ridicule it. Dietzsch mentions the solubility test in a mixture of ether and alcohol, the butyric ether test, and that of the smoking wick immersed in the fat, but he limits the applicability of the butyric ether test to artificial butter made from rape-seed oil and tallow, or lard and tallow. He also states that if a piece of blue litmus paper is laid on genuine butter and the whole is exposed under a bell jar to the sun for several hours, the paper will turn red, while such artificial butter as that just mentioned will not give any change of color. *Elsner* (39), mentions no test that would come under this head. *Griessmayer* (52), describes the color test with sulphuric acid for rape-seed oil, lard and tallow, and applies the butyric ether test to the cooled residue of this test; he also describes the smoking-wick test for tallow, and the solubility test in ether and alcohol for lard and beef or mutton tallow, adding that if the butter contains less than ten per cent of these substances the test-glass must be put in cold water; the carbolic acid test is also described.

Husson (68) describes in detail two tests of his own. By the test of solubility in castor oil he distinguishes between butter, lard, oleomargarine and suet, the last two mentioned requiring the highest temperatures 50° to 70° C. for their solution. The behavior of these several substances on cooling is also different, excepting in the case of butter and oleomargarine; on treating these cooled mixtures with 90 per cent alcohol other differences in solubility are developed. He also distinguishes these substances from one another by their behavior with glycerine, and a mixture of alcohol and ether; an emulsion of the

butter in ten parts of glycerine digested with a mixture of equal parts of alcohol and ether gives two layers of solution, with, in the case of pure butter and oleomargarine, no deposit of solid matters between them. Lard and suet give decided deposits between the layers, and starchy adulterations will appear there; on cooling the solutions new deposits appear that differ in appearance especially under the microscope; tincture of iodine added to the solution gives other deposits, which, especially for oleomargarine, present characteristic appearances under the microscope.

Full courses of the qualitative examination of the butter for both inorganic and organic adulterations are given by Dietzsch, Elsner, Liebermann and Medicus; but so many of the adulterants included in this examination are rarely used that no further notice of these courses is appropriate here.

The general usefulness of many of these simple tests is very questionable, while most of them will answer well enough for distinguishing oleomargarine butter pure and simple, or a butter made from tallow, lard, and oil.

The second method of Husson's may in skilled hands be valuable as a means of distinguishing different fats used for the adulteration of butter. In the performance of this as well as of any of the other tests the operator should be perfectly familiar by his own experience with the behavior of genuine butter under like conditions; I have found that such experience is quite essential in the few trials that I have had time or occasion to make of some of these tests; and I have found that even then quite considerable additions of oleomargarine to genuine butter may escape certain identification.

Partial Quantitative Tests for Adulteration with Foreign Fats.

Some of these tests are the only ones that give positive and incontrovertible evidence of this adulteration.

Ballard (9) makes use of the behavior of butter and other fats with ether at 18.5° for a quantitative estimation of foreign fats in butter; these fats when treated with a certain proportion of ether leave a much larger residue than pure butter leaves.

The Pharmaceutical Society of Leipzig offered in 1876 a prize of 300 marks for the discovery of a safe and practical method of testing cow's butter for adulteration with foreign fats. This prize was taken by *Hehner and Angell* (60). Their process depends on the fact that cows butter yields a certain notable proportion of fatty acids soluble in water, which are not present in other animal fats; they therefore separate out and weigh the insoluble fatty acids; of these they found genuine butter fat to yield 86.5 to 87.5 per cent, while beef and mutton fat and lard yielded 95.5 per cent. The fat, filtered while melted, is saponified with an alcoholic solution of potash, as suggested by Turner, the alcohol is removed by heat, the soap dissolved in water and decomposed by a mineral acid, the insoluble fatty acids collected on a weighed filter, and thoroughly washed, dried and weighed.

Bachmeyer (8) gets good results with this method; so also does *Kraetschmar* (79) but he thinks that a higher limit must be allowed for insoluble acids in genuine butter fat, for he obtained 89.6 per cent

in one instance; so also *Kuleschoff* (80). *Bell* (12) made determinations of insoluble acids by this process in fifty samples of genuine butter, and obtained from 86 to 89.9 per cent. *Reichardt* (112) on the other hand claims that the highest limit allowed by Hehner and Angell is too high and that it should not be over 86.8, because mixtures of 10 per cent of lard with genuine butter yield only 87.4 to 87.9 per cent of insoluble acids. *Filsinger* (44) obtained 89 per cent of insoluble acids from a genuine butter, and therefore says that the highest limit must be raised; on the other hand he obtained from several artificial butters only 87.5 to 88 per cent of insoluble acids. *Sachsse* (119) found that considerable rancidity in the butter does not notably affect the results obtained; so also *Jones* (73), who found that the specific gravity may be raised or lowered by rancidity. *Fleischmann* and *Vieth* (47) examine 187 samples of butter by this method and also find a wider range of variation for insoluble acids than was allowed by Hehner and Angell; they were led to give special attention to the washing of the insoluble acids before drying to weigh; and instead of stopping when litmus paper was no longer affected, they continued till sensitive litmus tincture showed no acid reaction with the washings; they found that according as they washed with more or less care they obtained 87.5 to 90.5 per cent of insoluble acids from thirty samples of genuine butter; on using from 1.5 to 2 litres of water for washing instead of three-fourths of a litre they obtained from a large number of American and German butters but a trifle over 88 per cent of insoluble acids in the highest instance. Nevertheless, for some reason not given, they recommend that the highest allowable limit for insoluble acids in genuine butter be set at 89.8 per cent, and commend the process while saying that it would be more reliable if better means for washing the acids could be devised. *Muter* (98) shows that the insoluble acids must be boiled with water in order to wash them completely, and he does not allow them to solidify during the washing. *Blythe* (16) conducts the whole operation from saponification to the final washing of the acids in a weighed flask in which they are finally dried and weighed. *Hehner* (58) calls attention to the fact that the fatty acids increase in weight when kept at 100° C. for a long time. *Dietzell* and *Kressner* (28) show that the proportion of insoluble fatty acids yielded by vegetable fats is also high (95 per cent), so that the adulteration of butter with these oils can also be detected. *Jean* (70) modifies Hehner's process to avoid a source of error which he has observed, and which may account for the high yield of insoluble acids obtained by some analysts from genuine butter; he noticed that if the alkaline soap of the mixed soluble and insoluble acids is at once decomposed a portion of the former will be taken up by the latter and retained with much obstinacy; he therefore makes a magnesium soap by adding magnesium sulphate in excess to the solution of the soap; a soap of the insoluble acids is thus precipitated, which is collected on a filter and washed, and then decomposed by acid; the insoluble acids thus obtained are prepared for weighing in the usual manner. Good butter did not yield over 88.2 per cent of insoluble acids.

Muter (99) describes a long process for determining the yield of both insoluble and soluble acids; the former are determined in the usual manner: the filtrate and washings are saved, the total free acidity determined in them; then the total sulphuric acid, by precipi-

tation with barium salt; the combined sulphuric acid, by evaporation of a portion of the washings to dryness, and igniting and weighing the residue of potassium sulphate; thus all the necessary data are given for calculating the acidity in the washings due to the soluble fatty acids. *Dupre* (38) questions the reliability of this method, although he cannot account for the marvellously accurate results obtained by its author. He attains the same end more simply. A measured quantity of a normal alcoholic solution of sodium hydrate is used for saponification, and a slight and known excess of a standard acid is added to decompose the soap; the filtrate and washings from the insoluble acids are saved and titrated, and the acidity due to the soluble acids is easily calculated. *Jones* (74) describes a similar process: the acids are washed and weighed in a flask as described by Blythe above, but the saponification is conducted in a smaller, strong flask, closed with a rubber cork tied in, to prevent volatilization of the soluble acids during the operation. *Perkins* (105) saponifies, decomposes the soap by oxalic acid in slight excess, and washes the insoluble acids as usual, and saves the filtrate and washings; of these he distils off an aliquot part, and determines the acidity by titration; the insoluble acids he dissolves in alcohol, and titrates an aliquot part of this solution also.

Koettstoerfer (77) takes advantage of the fact that the larger the proportion of pure butter in a mixture the larger, of course, the proportion of butyric and other acids with lower molecular weights. He uses for saponification an excess of normal alcoholic solution of potash, and by titration with half-normal acid determines the excess of alkali; he proved that one gram of pure butter required 221.5 to 233 milligrams of potassium hydrate for saponification, and one gram of other animal fats from 195.8 to 197 milligrams. He takes 227 milligrams as the average for genuine butter, and 196.5 for lard, oleomargarine, tallow, etc., and makes the process successful and quick. Like Hehner and Angell's method, it can be applied to rancid butter.

Hehner (59) first attempted to determine the soluble acids by distilling them off and titrating the distillate; but as he was unable to get the whole amount of from 6 to 7 per cent of volatile acids in the distillate, he gave up the method and turned his attention to the determination of the insoluble acids as above. *Heintz* (62) attempted the titration of the soluble acids in the mixture with the insoluble, without first filtering out the latter, but also without success. *Lechartier* (84) distilled off the volatile acids, saturated them with barium hydrate, evaporated, and weighed the residue: 50 grams of pure butter gave at least 6 grams of this salt, while oleomargarine butter did not yield a twentieth of this quantity; but the process is a tedious one. *Reichert* (111) by using always the same quantity of butter, of alkali for saponification dissolved in the same quantity of alcohol, adding the same quantity of acid for decomposing the soap, collecting a certain quantity of the distillate, and titrating it with a one-tenth normal alkaline solution, obtained very constant results; an average of 14 cc. of this alkaline solution being required to neutralize 50 cc. of the distillate from the acids yielded by 2.5 grams of the filtered butter fat, while for oleomargarine only 0.95 cc. of the alkaline solution was required, and for lard 0.3 cc. He affirmed that 10 per cent of any of these foreign fats, whether animal or vegetable, in butter, can be detected by this method, and that where the distillate requires only 12.5 cc. of the alkaline solution the butter may be considered as adulterated. *Medicus*

and *Scherer* (92) test this method with good results. *Meissl* (93) approves the test highly; but he takes twice as much butter and a weaker alcohol, 70 per cent instead of 80 per cent for the solution of the alkali for saponification, in order to avoid the loss of volatile acids by etherization during saponification; he tested 84 samples of butter by the method and concluded that if 110 cc. of the distillate from the acids yielded by 5 grams of butter required less than 26 cc. of one-tenth normal alkali for neutralization the butter should be regarded as adulterated. *Ambuhl* (2) says that this process possesses every advantage over Hehner's, and that nobody uses that now. He finds that the volatile acids from 2.5 grams of butter require for neutralization an average of 14.7 cc. of one-tenth normal solution of alkali.

In this connection reference should be made to the statement of *Dupré's* already alluded to, that unless the saponification of butter by an alcoholic alkaline solution is conducted in a closed flask, some loss will occur by volatilization of ethers formed during the process.

Husson (69, 68) treats the butter with ten times its weight of a mixture of equal parts of alcohol and ether; by the behavior of the butter with this solvent at different temperatures he determines the casein, margarine, oleine, butyrine and its associates, and water; the operations require much time and several weighings, and the strength of the solvents must be carefully adjusted, but results are obtained that in some cases, especially when combined with a microscopic examination of the products, might be valuable for confirmation of doubtful results obtained by quicker if less accurate methods. But without making so complete an examination as this in all cases, he tests for adulteration with foreign fats generally, by weighing the dried deposit left after this mixture, first heated to 30°C., has been kept at 18° for 24 hours; this deposit should not exceed 40 per cent of the butter nor fall below 35 per cent; if it is in excess the butter was adulterated with beef or mutton suet, if it is deficient oleomargarine or lard was used as an adulterant. *West-Knight* (133), precipitates from the solutions of the acids of the butter obtained by saponification, etc., the oleic, palmitic and stearic acids as barium salts; the salts of butyric acid and its associates are not precipitated; the method does not look promising.

Tests for adulteration with water and other matters not fat.

v. Babo (7,46), pours over a certain volume of the butter in a graduated tube, the butter being melted in the tube by a gentle heat in order to facilitate the correct reading of its volume, the same volume of ether, and mixes by shaking till the butter is completely dissolved; then to hasten the complete separation of this solution from the particles of water and other matter suspended in it, he puts the tube in a tin cylinder to the neck of which a strong cord is fastened, attaches the other end of the cord to a small roller in the end of a stout stick about eight feet long, plants the other end of the stick in the ground and gives its upper end such a rotary motion as to cause the cylinder to fly off and revolve in a nearly horizontal plane very rapidly; by this means after 60 to 80 revolutions the separation of the two liquids is made quite complete, and their line of demarcation is sharply defined. *Heeren* constructed a butyrometer for use on this principle which was attached to a horizontal wheel that could be rapidly revolved; the butter was however not dissolved in ether but simply melted in the grad-

uated tube; after revolution for two minutes the fat was completely separated from the other matters. Of twenty-one samples of butter examined in this way not one yielded less than 82 per cent of fat by volume, but the butter which contained the most fat was not always the highest priced sample. A similar and better instrument has been constructed by *Lefeldt* which gave nearly as good results as could be obtained by the gravimetric method. *Birnbaum* (13) applied *v. Babo's* simple centrifugal apparatus with melted butter, and after 60 to 80 revolutions obtained a sharp demarcation between the fat and the water and other matters; or if the tube was kept in warm water for a considerable time and occasionally revolved rapidly by rolling it in a vertical position between the palms of the hands a very fair separation of the water from the fat was obtained. *Hoorn* (64) in a graduated tube with a narrower graduated part at the lower end, melted 10 grams of butter and mixed it with 30 cc. of petroleum ether by shaking; the water and other matters not fat collected in the narrower tube; calling a cubic centimetre of these matters one gram he found usually 12 to 14 per cent in good butter, and over 20 per cent only in adulterated butter; the result is more reliable if the first etherial solution is decanted off and the residue is shaken up with a fresh quantity of the ether. All other adulterations that are not fatty will remain with the water. *Jean* (70) exhausts 40 grams of the butter with ether or carbon disulphide, evaporates the extracts to dryness and weighs; the difference gives water, caseine, salts and other matters. *Johanson* (71) gets very good results with a method precisely like Hoorn's.

In monograph works *Blythe* (14) describes for the testing for *foreign fats* only Jones's method as modified by himself. The *water* he determines by drying a gram on the water bath, the *fat* by melting it in this dried residue and decanting off as much as possible, and dissolving out the rest with ether, and the *ash* by ignition; the difference between the sum of these and the weight of butter taken gives the *curd*. *Dietzsch* (29) for *foreign fats* describes only Hehner's method, but he admits, that in view of the conflicting statements as to the limits to be allowed for insoluble acids in pure butter, the method affords no guarantee of accuracy, and needs further examination; he has himself obtained in several cases from 88 to 88.2 per cent of insoluble acids from artificial butter, and never over 87.5 per cent from genuine Swiss butter. For *water and other matters not fat* he follows the methods first given by Duflos and Hirsch in 1842 (36) which consists in melting a considerable quantity of the butter in a weighed cylinder with twice its weight of water, the cylinder being inverted and corked, and, after the melted fat has become clear setting the whole aside till the butter solidifies and then removing the cork and draining off the water with the curdy particles suspended in it; the residue of butter in the cylinder is then weighed.

Fleischmann (46) for *foreign fats* with Hehner's methods obtained from 89 to 90.7 per cent of insoluble fatty acids from samples of genuine cow's butter, and states that Hehner's limits thus appear to be too low; and the real limit is so near the lowest for oleomargarine as to detract much from the value of the method — and that for butter from milk of other animals Hehner's rule does not hold. *Griessmayer* (52) gives for the examination for *foreign fats* Hehner's, Koettstorfer's and Reichert's methods without criticism; for *water and other matters not fat* he follows Duflos and Hirsch. *Hassall* (56) for *water and other matters* melts the butter in a tube and gauges the

proportion of these matters by the space that they occupy, and says that the test should be taken from the middle of the piece of butter, as the outside may have lost its surplus water.

Husson (68) gives only his own method for the examination for *foreign fats* already described above; for *water, etc.*, he gives a method essentially like that of Duflos and Hirsch; he observes that when a knife is plunged here and there into butter which has been loaded with water, droplets of the liquid appear in the track of the knife, and that butter with an excess of water is granular and crumbly. *Elsner* (39) describes for the examination for *foreign fats* Hehner's, Koettstorfer's and Reichert's methods, and commends them all as reasonable; for *water, etc.*, he follows Duflos and Hirsch. *Liebermann* (86) mentions no method for *foreign fats*, and for *water, etc.*, follows Duflos and Hirsch. *Medicus* (91) for foreign fats describes Hehner's, Reichert's and Koettstorfer's methods, and also Perkins' with an unfavorable comment; for the *water, etc.*, he takes up the fat with ether and separates it from the water and other matters by decantation.

Results of the examination of samples of butter received from the Inspectors under the State Board.—This examination was confined to the test for *foreign fats* and for *excess of water and other matters not fat* and to the *microscopic examination* of such samples as proved to be oleomargarine butter. For foreign fats Reichert's method was followed with much satisfaction; when all the necessary solutions are once prepared the analysis is made with comparatively little trouble, with less, in fact, than is allowed even by those who praise it most; its author says that a current of air must be passed through the liquid in the flask while the distillation is going on, to prevent bumping, and Ambuhl says that all attempts to dispense with this precaution by the use of pumice stone, platinum scraps and the like failed. Nevertheless, finding it very inconvenient to use the current of air, I ventured to try a combination of short spirals of platinum wire and pieces of pumice stone together, and with complete success; the ebullition continued from beginning to end as quietly as could be desired.

For water and other matters not fat Hoorn's method was adopted, after several unsuccessful attempts with the method of Duflos and Hirsch, which is given in so many of the monograph works. This method appeared to be altogether too clumsy and inaccurate, for most of the curd, after first settling to the bottom of the water, would soon rise to the lower surface of the butter and adhere there when the butter solidified, and it could not be removed without carrying away also considerable quantities of fat. Where such wide variations must be allowed in the proportion of water in butter, as has already been shown, it seemed to be unprofitable to take more time and make more accurate determinations than would be yielded by Hoorn's method. About 10 grams of the butter were put in a tube graduated to tenths of cubic centimeters and melted by immersing the tube in warm water; the volume of the melted butter was then noted, the petroleum ether added, and after corking the tube the solution of the fat was effected by vigorous shaking; then, after standing three or four hours, the volume of the matters not fat collected at the lower end of the tube was noted and the per cent by volume calculated.

My results are set forth in the following table; the figures in the third column represent the number of cubic centimeters of one-tenth normal solution of alkali, required to neutralize the acids in the first 50 cc. of the distillate from the fatty acids yielded by 25 grams of butter.

Inspector's number of sample.	Trade designation.		Cubic centimeters of alkaline solution required.	Volume per cent of water, etc.
122a	Oleomargarine butter procured at my request,		*1.5	
122b	Oleomargarine butter procured at my request,		*1.7	
236	Dairy butter, costing lb.	29c	14.9	14.79
237	Dairy butter,	30c	13.7	14.53
238	Cooking butter,	18c	13.	15.55
239	Dairy butter,	25c	13.1	22.58
240	Best creamery,	40c	13.5	15.2i
241	Best dairy,	44c	13.6	15.15
242	" creamery,	38c		19.53
243	Good dairy,	26c	14.	16.01
244	Fair dairy butter, sold at	20c	15.1	14.26
289	Butter	32c	*1.	10.66
290	"	32c	*1.3	15.22
291	"	20c	12.8	16.87
292	"	20c	*1.6	13.79
293	"	22c	13.7	19.55
294	"	26c	*1.6	10.80
295	"	26c	12.7	30.75
296	"	26c	15.8	11.17
297	"	24c	14.5	14.94
331	Dairy butter,	28c	*1.6	10.
332	Splendid dairy butter,	30c	13.	14.79
333	Extra fine dairy,	33c	18.8	12.32
334	Splendid dairy,	30c	15.5	13.19
335	Creamery butter,	32c	*2.2	
336	Good dairy,	30c	14.8	26.27
337	Roll butter,	35c	*1.8	7.74
338	Good creamery,	28c	14.7	12.80
339	Fair table,	25c	15.3	18.15
340	Dairy butter,	30c	*2.1	9.71
357	Genuine dairy,	30c	14.1	16.52
358	Roll butter,	27c	*2.7	9.62
366	Good dairy butter,	30c	*10.2 11.6 11.4	15.56
2001	Butter,	36c	12.8	15.
2002	Butter,	26c	15.9	11.47
2003	Oleomargarine butter, acknowledged to the inspector, Mr. Munsell,	26c	*	12.71
2004	Oleomargarine butter, acknowledged to the inspector, Mr. Munsell,	26c	*	8.84
2005	Oleomargarine butter, acknowledged to the inspector, Mr. Munsell,	20c	*	11.52
2006	Butter,	30c	15.5	23.32
2007	"	48c	14.9	16.16
3102	Best country butter, from my own table,	32c	14.1	
3103	Best country butter, from my own table,	32c	13.9	
2016	Western butter,		14.4	10.45
2017	Butter, acknowledged by seller to be mixture of lard and butter,		*5.4	13.27

Samples *122a and 122b were bought for oleomargarine butter at my request, that I might test my method of analysis—and for the same reason samples 3102 and 3103 were taken, one from my own table and the other from the table of a friend, in order to test the process by butter known to be genuine; these four were the first samples examined. The oleomargarine butters designated by an * are betrayed at once by the test. In the case of *335 the inspector stated that the seller acknowledged it to be a mixture of oleomargarine and real butter, and that it was made in Ohio, at large factories, where oleomargarine is mixed with cream and churned; and he calls it creamery butter because it is made at a factory and not on farms or at small dairies. The result of the analysis shows that very little cream was put into the churn with the oleomargarine. In the case of *358, the seller was made by the inspector to acknowledge that it was oleomargarine butter, and he gave the information that the practice is quite common to put such butter up in rolls and stamp it.

On receiving these letters from the inspector I took no particular notice of the numbers of the samples, and forgot them long before I made the analyses; now, on the occasion of writing this report the numbers of the samples and the inspector's statements in regard to them are brought together for the first time; my results are in full accord with these statements, and the reliability of the test is confirmed, if indeed it needed any confirmation. Three determinations of volatile acids were made with *366, because it was the only sample that seemed to be a mixture of genuine butter and oleomargarine; the last two tests were made with great care, while the first was made with less particular observance of all the necessary precautions.

As those who have most carefully tested the method of analysis in Germany have decided that where a sample of butter examined in this manner requires less than 12.5 cubic centimeters of the standard alkaline solution ($\frac{1}{10}$ normal) to neutralize the volatile acids yielded by 2.5 grams of the pure fat of the sample, it is to be regarded as adulterated with foreign fats, and as the quantity of alkali required in this case falls so much below that required in the case of every other sample examined by me, that was not oleomargarine butter pure and simple. I therefore conclude that this sample *366 was taken from a mixture of genuine butter with oleomargarine. Samples *2003, 4 and 5 were not tested for foreign fats because since the sellers acknowledged to the inspector, Mr. Munsell, that they were oleomargarine butters, there appeared to be no object in testing them.

As to the determination of water and other matters not fat, allowance must be made in some cases for the fact that the examination was not made till quite late; the water had collected in a few instances in the cavities left on taking out the small samples some time previous for the determination of volatile acids, so that it was difficult to get samples for these last determinations without too much or too little of this water. But it was noticed that in just those cases, viz.: *239, 242. 293, 295 and 2006, where the analysis indicated an excess of water there was an unusually large collection in these cavities; second determinations were made of water, etc., in the worst of these cases, after pouring out all that had collected in the cavities; they then, of course, yielded less water, but in the case of *295 the proportion was still as high as 27 per cent; this is lower than it should be, because some of

the water of the portion tested had unquestionably escaped into the adjoining cavities and was poured out with the rest. This butter was undoubtedly adulterated with water, since 20 per cent of foreign matters of all kinds is the highest allowed by any authority. As to the other samples which yielded so large a per cent of foreign matters not fat it can only be said with certainty that they are suspicious. I did not expect to find this kind of adulteration and therefore did not examine the samples for it at once on their arrival; when the tests were made at last, it was rather with the expectation of proving that such adulteration does not occur in our butter trade.

Microscopic examination of oleomargarine butters.—This examination was made mainly for the purpose of ascertaining how generally the statements of *Piper* (p. 514) concerning objects found by him in western oleomargarine butters apply also to butters of this class as sold in New York. As the general result of my examination I may say that, while in one sample I found indications of bacteria, and in another of fungoid vegetation, and of remains of tissue in several, these objects were of rare occurrence, and I do not consider it as proved that some of them may not be found in genuine butter of poor or ordinary quality with as much frequency; therefore, till I shall have subjected as many genuine butters to the same rigid examination, I cannot be prepared to say that their occurrence is characteristic of oleomargarine butter.

Cheese.

Literature.—The subject of the adulteration of cheese receives only brief mention either in the journals or in monograph works on adulteration of food.

The Analyst (1881, p. 29) quotes from the Chicago Journal of Commerce the statement that soapstone, soda and potash are added to cheese.

Hassall (56) states that cheese is adulterated with potatoes in Thuringia and in Saxony, and that bean meal is sometimes added in the place of potatoes; that Venetian red has been detected in several cases in the coloring of the rind, and as this color sometimes contains lead, and the rind is sometimes eaten, the fraud may be dangerous. He also says it is stated that blue vitriol and arsenic (green ?) are sometimes added, perhaps to give the appearance of age to the cheese, but he has never found them.

Elsner (39) says that adulterations of cheese are not known. He mentions oleomargarine cheese as an article recently introduced in Germany. *Griessmayer* (52) also says that cheese is not adulterated; but he mentions in appropriate terms a practice of soaking certain kinds of cheese, such as Limburger, in urine in order to give them in a short time the appearance of ripeness; such cheeses can be made to show the reaction for murexide. He mentions the possible occurrence of poisonous metals, as copper, lead or zinc, in cheese, owing to carelessness in keeping it in metallic vessels or wrappings.

Fleischmann (46) quotes the results of Vogel's examination of cheese for lead; beyond two inches from the rind no lead was found even in cases of cheese wrapped in very inferior tinfoil containing much lead; but in such cases lead was detected in the portions of the cheese im-

mediately under the rind; 0.56 per cent of lead was found in one instance in the rind of a cheese wrapped in tinfoil containing 15 per cent of lead. Such cheeses are so little used in this country, however, that this matter has no general importance; but the information may serve as a warning to those who do eat them to be careful of eating the rind.

The same author mentions also the use of veratrin, sulphate of zinc and arsenic to give to green cheese the strong, biting flavor of old cheese, and the addition of blue vitriol to the milk in order to prevent huffing of the cheese.

Liebermann (86) mentions the danger in metallic wrappings, and states that verdigris is sometimes sprinkled over the cheese to give it the appearance of age. *Blythe* (14) states that washes containing arsenic and lead have often been applied to ward off flies, and as some people eat the rind, such practices may be dangerous.

Lard cheese.— About ten years ago dairymen were much concerned lest the manufacture of cheese from skimmed milk and oleomargarine should seriously injure the reputation of American cheese abroad, and in that way hurt the dairyman's business here. Whatever chance this mode of making cheese may have had for success, it is now quite supplanted by the lard cheese which is made at over twenty factories in this State, under patents issued to H. O. Freeman in 1873, and to William Cooley in 1881.

In this process an emulsion of lard is made by bringing together in a "disintegrator" lard and skimmed milk, both previously heated to 140° Fahr. in steam-jacketed tanks; the "disintegrator" consists of a cylinder revolving within a cylindrical shell; the surface of the cylinder is covered with fine serrated projections, each one of which is a tooth with a sharp point; as this cylinder revolves rapidly within its shell, the mixture of melted lard and hot skimmed milk is forced up in the narrow interspace, and the lard becomes very finely divided and most intimately mixed or "emulsionized" with the milk. This emulsion consists of from two to three parts of milk to one of lard; it can be made at one factory and taken to another to be used for cheese, but it is usually run at once into the cheese vat.

In making the cheese a quantity of this emulsion containing about 80 lbs. of lard is added to 6,000 lbs. of skimmed milk, and about 600 lbs. of buttermilk in the cheese vat, and the lard that does not remain incorporated with the milk or curd, usually about 10 lbs., is carefully skimmed off. These quantities of the materials yield 500 to 600 lbs. of cheese, containing about 70 lbs. of lard, or about 14 per cent; about half of the fat removed in the skimming of the milk is replaced by lard (Munsell). It is claimed that no alkali or antiseptic is used, and that only the best kettle-rendered lard can be employed, because of the injurious effect of any inferior article on the quality of the cheese, and that before even this lard is used it is deodorized by blowing steam, under 80 lbs. pressure, through it for an hour.

According to many witnesses the imitation is excellent, for experts have been unable to pick out lard cheeses from a lot of these and full cream cheeses of good quality together; and it may therefore be safely presumed that the general public would be quite unable to distinguish one from the other.

The *statistics of the manufacture of this kind of cheese* as gathered from various sources, and partly by Inspector Munsell are about as

follows: Thirteen of the "disintegrators" are in operation, all in this State, and none elsewhere. The production of cheese at the twenty-three factories engaged in the manufacture in this State during the six months ending November 1, 1881, was stated to amount to 800,000 lbs. None is made in other States, although it was stated before the *Assembly Committee on Public Health* (43), in 1881, that it was made at the West. Before the same committee it was stated that some of the cheese was sold in New York city for consumption, but according to the best of my information, most if not all of it is exported. It is claimed that it brings from eight to ten cents a pound when full cream cheeses sell at twelve cents, and "full skim" cheeses at four to five cents; but New York dealers tell the inspector that the cheese brings but four cents a pound when its true character is known, and that is for exportation only. The inspectors have not been able to find any cheese in the city markets which they had any reason to suppose to be lard cheese.

In two respects this kind of cheese can be considered as a fraud under the new food and drug law, unless sold under its distinctive name. It contains less fat and fat of a cheaper kind than the ordinary full-cream cheese contains, and secondly, there are some grounds for the belief that the fat which is substituted for the butter fat is less wholesome than that. *Rubner* (117) in some investigations on the assimilation of various articles of food by the human subject found that lard was less digestible than butter: and the objection to oleomargarine butter on the ground of its indigestibility as compared with genuine butter (p. 514) may apply perhaps with more force to lard cheese; it only remains to determine by experiment whether the digestibility of the substances is increased by the operation of emulsionizing. The question of the digestibility of this cheese as compared with other kinds could be satisfactorily determined only by a series of comparative digestion experiments, after the fashion of Rubner's investigations.

"Skim cheese;" "anti-huff cheese."— Cheese is made, as is well known, from "full skimmed" milk, without any attempt to replace the fat removed for butter; it is doubtful whether such cheeses are anywhere sold in a way to deceive consumers as to their character. To improve the quality of these cheeses and especially to prevent them from puffing out or "huffing" as it is technically called, from the abnormal generation of gases in the interior before they become fully ripe, patented "anti-mottling" and "anti-huffing" extracts are employed, consisting, it is claimed, only of caustic and carbonated alkali, saltpetre and a little annatto for coloring, dissolved in water. A qualitative analysis of one of these extracts by both Mr. Munsell and myself confirmed this claim in one case; but another extract, said to be used at the West, was found to consist almost entirely of borax which is a well known antiseptic. The quantity of alkali and saltpetre said to be added to the cheese in this operation is small, in all less than five ounces to the milk and sour buttermilk for 100 pounds of cheese, and a portion of this must remain in solution in the whey; and there is no satisfactory evidence that such a quantity of borax as could be added to the cheese without affecting its taste would be prejudicial to the health for any ordinary quantity of cheese eaten. *Gruber* (52 *a*) shows that when this substance is taken into the system it seems to leave the organism very quickly and without affecting the system in any injurious manner.

As to the *statistics of the manufacture of anti-huff cheese,* it is stated that in the most important section of this State for dairy products 4,500 cheeses of the best quality were made this year of skimmed milk and sour buttermilk with the aid of this extract. Before the *Assembly Committee* (43) it was affirmed that this cheese is consumed to some extent in this country, but most of it is exported. It is claimed that nearly the same prices are obtained for the cheese as for full cream cheese, and that it is a good and wholesome article of food, containing nothing but what is found in other food. On the other hand it is asserted that the excessive quantity of alkali supposed to be in the cheese makes it unwholesome, and that like the lard cheese it is a fraud on the public unless sold under a distinctive name; bringing nearly the prices of a full cream cheese, it is taken by consumers to be such. As to the first point there is no evidence pro or con, and the presumption is, as above stated, that there is no excessive quantity of alkali in the cheese; as to the latter point, it can be left to the interpretation of the law; without question a valuable constituent of the cheese has been removed and nothing of the same character has been substituted for it.

Water and fat determined were in small samples, each one of skim cheese made without anti-huffing extract, and with it; both samples were taken with an ordinary cheese-tryer by Mr. Freeman, the patentee of the process, and sent through Mr. Munsell to me. The results of this partial analysis are given below.

	Water.	Fat.
Anti-huff cheese....................................	47.56	14.48
Ordinary skim cheese....................................	47.00	16.77

There is nothing unusual in the composition of these samples, as compared with skim cheese in general.

Poisonous cheese. — A sample of cheese, said to have produced sickness on the part of those who ate it, was sent to me by the Secretary of the Board, who received it from Inspector Smith. Cases of so called "poisonous cheese" occasionally appear in different parts of this country, and in other countries. *Husemann* (67 a), quoted by *Fleischmann* (46), mentions a number of instances from all parts of Germany, and also in England and Russia, resulting from eating old and especially sour milk and soft rennet cheeses. Scarcely ever is the result fatal, and recovery is rapid, because the vomiting which is among the first symptoms relieves the system of the dangerous matter. *Voelcker* (131 a) after noticing cases of sickness produced by cheese containing copper or zinc sulphate, that had been added often surreptitiously by the dairymaid to prevent "heaving" of the cheese, gives an account of a case where all the cheese of a certain "make" sold in different places produced sickness; the cheese presented nothing abnormal in appearance, but his assistants on eating less than a quarter of an ounce of it were taken with violent vomiting and pain in the bowels, and a disagreeable mercurial after-taste was left in the mouth; no metallic poisons could be found in it however, nor any thing else abnormal except an apparently larger quantity than usual of fatty acids, giving a strong acid reaction to the cheese. He suggests that the poison is identical with the so called sausage poison of German sausages made largely from coagulated blood, and says that a similar poison appears to be generated sometimes in pickled

salmon, smoked sprats, pork or tainted meat, and that rancid butter may act as a poison. It disappears from the cheese when quite decayed. I have on previous occasions examined such cheese both chemically and with the microscope, without finding any cause for the physiological effect produced by it, or any thing unusual; in one case the cheese was excellent in quality otherwise, but it nevertheless when eaten to test the truth of the allegation against it, made me quite ill with the usual symptoms for a short time.

In the present instance some of the cheese was offered to some kittens which are kept in stock for the use of the anatomical department of the University; at first only one would eat it, and that one appeared to be quite sick the next day. After her recovery this same kitten ate of the cheese again without any noticeable ill effects, and several others also ate of it without harm; it appears, therefore, that the illness of the first animal may as well have been caused by over-eating of rich food as by any supposed poisonous character belonging to the cheese.

I examined the cheese for poisonous metals in the rind, and for matters of the nature of alkaloids in the other part; no metals were found. With respect to the second test, a very small quantity of a substance, precipitated by alkali, soluble in ether, and giving with platinum chloride a yellowish, flocculent precipitate was obtained; these reactions indicate an alkaloid, but I have not been able as yet to carry the examination any further, and, moreover, it is not at all unlikely that a substance of the same character may be found in any ripened cheese as one of the normal products of the putrefaction; therefore, this result obtained with the poisonous cheese can have no significance till normal cheese has been examined in the same manner without finding any evidence of the presence of alkaloids. For the present, therefore, we can only repeat what others have said, who have given this matter their attention, that the cause of this peculiar property of cheese is probably an unknown organic substance, resulting from an abnormal process of ripening.

LARD.

Literature.— According to older writers on the subject of adulteration this substance was frequently adulterated. *Hassall* (56) says that it is extensively adulterated with water and starchy matters to make weight, and with salt, alum, potassium and sodium carbonates; and lime — as milk of lime — to increase its capacity for water, the cheapest make-weight of all; good lard contains no water. *Hoskins* (67), writing in 1861, states that this adulteration of lard was very common then, as much as twenty-five per cent of water being sometimes found in it. *Dietzsch* (29) says that water and lime are the chief adulterants, sometimes to the extent of forty per cent, but that other substances, such as chalk, plaster, clay, starch and flour, are rarely added. *Elsner* (39) says that sunflower-seed oil is sometimes used as an adulterant, and often water, with borax, soda or lime. Other writers, accessible to me, do not mention the subject, and there is no literature concerning it in the journals, with the single exception of the *Bulletin of the National Board of Health*, in Supplement No. 11, where Dr. Smart states that the quality of the samples of lard purchased in Washington was so uniformly excellent that he discontinued the examination.

The detection of these adulterants mentioned above, especially of water and alkaline substances, is easy. On keeping the lard in a melted condition for a short time the water and other impurities collect at the bottom, and if milk of lime, soda, or any other alkaline substance was added also, the water will show the usual alkaline reaction with litmus or turmeric paper; after the lard has solidified on cooling a channel is made through it to the water, and the latter is poured out and weighed for a rough determination of the percentage of impurities; this water can then be examined chemically for matters in solution, and if it is turbid, as is often the case, it can be examined for starch with the microscope by which the addition of potato flour would be indicated.

Results of my examination of lard.— Twenty-eight samples were received, mostly from Mr. Colby. They varied widely in quality — some were pure white in color, granular in texture, and free from any unpleasant odor; others had a texture reminding one of cotton, and emitted a disagreeable odor, which was much worse when the samples were melted; some again melted quickly to a clear oil, while others would not yield a clear liquid even when kept melted for hours. Aside from the question of adulteration, some of these lards which were sampled for me could not be considered as agreeable or as wholesome articles of food.

Results :—

Inspector's No.		Price per pound.		Analysis.
233		14 cents.		No water.
234		15 "		7.5 per cent water.
235		15 "		No water.
245		18 "		Little water.
246		16 "		No water.
288		16 "		7 per cent water.
340		17 "		6.3 per cent water.
341		16 "		No water.
342		16 "		No water.
357	pail lard	17 "		No water.
359	pail lard,	20 "	(leaf lard)	No water.
360		17 "		No water.
361		16 "		No water.
362		17 "		4 per cent of water.
363		16 "		No water.
368	pail lard,	18 "		No water.
369		13 "		6.7 water.
370		18 "		No water.
371		17 "		1 per cent of water.
372		16 "		5.5 per cent of water.
373		15 "		Very little water.
374		15 "		2.3 per cent of water.
375		13 "		No water.
376		16 "		Very little water.
2008		18 "		No water.
2009		18 "		4.5 per cent water.
2010		15 "		4.5 per cent water.
2011		13 "		No water.

My results prove that the practice of watering lard prevails to some extent, but in no case did the proportion of water reach the high figures mentioned by some writers, and in no case was the water alkaline.

Olive Oil.

Literature. — According to all accounts olive oil appears to be one of the most largely and variously adulterated of all substances put upon our tables. Of course nothing can be added to it to make weight except cheaper oils, since it is a clear fluid at common temperatures, and will not take up water or salts of any kind. Poppy oil, cotton-seed oil, ground or peanut oil, sesame oil, rape-seed oil, colza oil, and even coal oil are mentioned as being usedfor this adulteration; and beech-nut oil, which is manufactured on a large scale in Germany and used as a substitute for olive oil, can of course also be used, and very likely is used as an adulterant.

In one of the older numbers of the Chemical News it is stated that cotton-seed oil is refined in England and sent in enormous quantities to Italy, notoriously for the adulteration of olive oil; and the ground nut is largely raised in Africa for its oil which is often sold in commerce as olive oil (Johnson's Cyclopædia).

There is no evidence that any of these adulterants are injurious to health, and their use is in violation of the law only in that a cheaper article is substituted for a dearer one with fraudulent intent. The occurrence of poisonous metals, such as copper and lead, may be a more serious matter from a sanitary point of view, although the quantity of these metals that might be taken into the system in the quantity of oil ordinarily consumed may be of small importance. Lead is added to correct rancidity and may remain dissolved in the oil (*Liebermann* 86); copper is used as acetate (*Cailletet* 20) to give to any cheaper oil, such as ground-nut oil, a greenish tinge, and the mixture is then sold as Malaga olive oil.

The detection of these adulterations and especially the identification of the oil used as an adulterant is beset with much difficulty. Nearly all the study of oil testing has had special reference to the adulteration of olive oil, and still there is no quick and satisfactory way of detecting these adulterations; evidence of the difficulty of this detection is found in the offer by the Chamber of Commerce of Nice (23), in 1869, of a prize of 15,000 francs for the discovery of a simple, rapid and practical method of detecting adulterations of olive oil.

As I find no reference to the matter since that time I conclude that the prize has never been taken.

Methods that have been proposed for the detection of adulteration of olive oil may be arranged under several heads.

A. Methods based on specific gravity or solidifying point.

B. Methods based on changes in consistency, produced by certain chemical agents, or the elaidin test.

C. Methods based on changes in color, produced by certain chemical agents.

D. Spectroscopic tests.

E. Miscellaneous tests.

A. Methods based on differences in the specific gravity of different oils, and in their solidifying point.— Olive oil has a lower specific gravity than most oils used for its adulteration. (Watts' Dictionary, IV, 180; Wurtz's Dictionnaire, II, 40.) *Payen* (103) and *Wurtz* mention special aræometers for testing olive oils, some being constructed for the detection of particular oils; it is stated by *Lefebre* (85) that if a mixture of olive and poppy oils is allowed to stand quietly for eight or ten days a partial separation of the two oils will take place, and the heavier oil will preponderate at the bottom, and by taking that part of the contents of the bottle for the test the aræometer will more distinctly show the adulteration. Oleometers are constructed for testing at 15° (*Lefebre*), or at 100° (*Laurat*). *Donny* (32) makes the specific gravity test simply by coloring a drop of genuine olive with alkanet, and depositing it in the suspected oil; it should remain stationary if the oil is pure. *Scheibe* (120) gives 0.923 for the specific gravity of cotton-seed oil, and 0.912 for olive oil, and holds that the specific gravity test and the elaidin test (see below) are the only means of detecting cotton-seed oil in olive oil.

From the meagre references to specific gravity tests of olive oil, in recent writings on the subject, it may be inferred that but little dependence is placed on it at present. *Dietzsch* (29) says that the test is useless, unless the adulterating oil makes up fifty per cent of the mixture.

Pure olive oil becomes whitish and opaque at from 6° to 8° C., while poppy oil does not assume this condition till the temperature falls to from -8° to -12° C.; a mixture of the two oils will congeal at a temperature between these points, and by taking advantage of the partial separation of the two oils by gravity, as mentioned above, any considerable adulteration with poppy oil may be detected by comparing the behavior at 6° C. of a sample taken from the top of the bottle with one taken from the bottom. *Dietzsch* (29) makes more account of this than of the specific gravity test; but as he puts the solidifying point of the best Provence olive oil at 2.5° C., while sesame oil begins to solidify at 0° C., this common adulterant might easily escape detection. Cotton-seed oil solidifies at -2° C., and ground-nut oil at -3° C. But according to him, as well as Payen, poppy oil endures a much lower temperature than olive oil before solidification.

B. Changes in consistency produced by chemical agents; the elaidin test.— *Poutet* (109) mixes the oil intimately with one-twelfth of a solution of 6 parts of mercury in 7.5 parts of nitric acid of 38° Baumé, and lets it stand twenty-four hours; poppy oil, especially, delays the solidification of the oil, and an addition of one-tenth can be detected. *Dumas* (36a) says that the method is in constant use. *Boudet* (17) substitutes a solution of hyponitric acid in nitric acid for the mercuric solution, but Dumas says that this is not so safe a test. *Barbot* (10) uses a solution of binoxide of nitrogen in nitric acid. *Crace-Calvert* (22) uses first nitric acid (sp. gr. 1.33), and then sodium hydrate solution (sp. gr. 1.34), or a mixture of nitric and sulphuric acids, and then sodium hydrate, or a solution of alkali alone, and then boiling; ground-nut oil becomes solid in five minutes with this last treatment. *Cailetet* (21, 140) uses a solution of hyponitric acid in sulphuric acid, which is also used by *Roth* (116), who passes a slow current of hyponitric acid through sulphuric acid of 40° Baumé for six to eight

days. A full account of the method and the reactions is given by *Grandeau* (51), who speaks very highly of it, and says that Roth's essay on this subject was rewarded with a prize by the Société Industrielle de Mulhouse. *Nicklès* (101) uses lime, slaked to a dry powder with water, especially for apricot oil; if 1.5 grams are added to 10 grams of the oil, and the mixture is boiled and filtered hot the filtrate remains clear if the oil is pure; but if one-tenth of apricot oil is added the filtrate becomes turbid; he thinks that poppy and ground-nut oil give the same reaction, but he was not sure that he had pure oils to work with. *Lailler* (82) uses a solution of chromic acid and nitric acid, which with pure olive oil gives after several days a solid mass; and he considers it safe to say that any oil which does not behave in this manner is adulterated. *Reynolds* (114) detects cotton-seed oil by a solution of mercuric nitrate, which gives with pure olive oil a hard brittle mass, but a doughy mass if cotton-seed oil is present. *E. Kopp* (78) adds to ten volumes of oil, one of concentrated nitric acid, and a few pieces of copper; as soon as the gas bubbles up through the liquid freely the whole is stirred together, and after a few minutes stirred again, and the mixture is put in a cool place; the purer the oil is, the sooner solidification follows, and the whiter and harder the elaidin. *Scheibe* (120) holds that the specific gravity test (see page 536), and the elaidin test furnish the only safe means of detecting cotton-seed oil; if present in the olive oil, the solidification is more or less imperfect, and the oil is colored brown.

Dietzsch (29) prefers Barbot's method, as used by Kopp, above, but takes equal volumes of the acid and the oil; he states that after three to six hours Provence oil yields an almost white, buttery mass, but sesame oil a red color, beech-nut oil, reddish-yellow, rape oil and cotton-seed oil, brown, while the solidification is delayed from ten to twenty hours, by these adulterants; poppy oil does not solidify at all.

Other recent works consulted by me do not mention the subject.

C. Tests by changes of color produced by chemical reagents.—*Barbot* (10) notes the changes of color produced by 2 grams of a saturated solution of binoxide of nitrogen in nitric acid, mixed with 20 grams of the oil, while *Dissel* (30) uses nitric acid alone. *Heydenreich* (61) uses only sulphuric acid, one drop of which is added to ten or fifteen drops of oil, on glass over white paper. *Peuot* (104) uses in the same way 20 drops of oil and a drop of a saturated solution of potassium dichromate in concentrated sulphuric acid. *Behrens* (11) mixes with the oil about its own volume of a mixture of equal parts of sulphuric and nitric acid, which gives a bright green with sesame oil and distinguishes it from all others. *Calvert* (22) gives an elaborate series of color reactions with sulphuric acid of different densities, nitric acid of different densities, sulphuric and nitric acids together, nitric acid followed by sodium hydrate and aqua-regia, followed by sodium hydrate. *Cailletet* (21,140) uses a mixture of dilute sulphuric acid and concentrated nitric acid, a solution of hyponitric acid, in nitric acid, and also brings together mercury, concentrated nitric acid and the oil, thus getting the combined action of mercuric salt and binoxide of nitrogen dissolved in nitric acid. *Chateau* (24,140) uses for a general method of analysis of commercial oils, liver of sulphur, syrupy zinc chloride, concentrated sulphuric acid, fuming

stannous chloride, syrupy phosphoric acid, and mercuric nitrate alone and in conjunction with sulphuric acid. *Hauchecorne* (57) used peroxide of hydrogen, but afterwards prefered concentrated nitric acid; he gives the colors yielded by several *crude* oils. *Langlies* (83a) gives particulars as to the strength of acid used. *Dragendorf* (33) gives color reactions of oils with ferric chloride. *Flueckiger* (48) remarking that the value of the color reactions with concentrated sulphuric acid is materially lessened by the carbonization and blackening that soon sets in, makes the valuable suggestion that, as carbon disulphide gives no colors at all with the acid, it can be used to dilute the oil.

Wideman (134) describes some reactions of refined cotton-seed oil; it gives a violet color with concentrated sulphuric acid; a blood-red color and much evolution of sulphurous acid with sulphuric acid and potassium dichromate; with sodium hydrate of 1.21 sp. gr. it thickens, becomes straw yellow, and bluish violet on the surface after a long time. A *writer in Les Mondes* (Chem. News, 44, 1880, p. 216) states that the least trace of sesame oil is detected by the red color obtained on adding a little sugar to hydrochloric acid of 30° Baumé, and mixing with it an equal bulk of the oil; and for cotton-seed oil, equal volumes of the suspected oil and nitric acid of 40° are mixed; if this oil is present the mixture takes a coffee color. *I. Walz* (132) describes some reactions of a syrupy solution of antimony terchloride with olive and other oils; it gives with olive oil simply a whitish emulsion, soon becoming green, without any rise of temperature, while cotton-seed oil turns chocolate brown, with much evolution of heat, and soon solidifies. In a recent number of the Druggist's Circular it is stated that, when pure olive oil is heated to 250° C. in a test tube, it becomes paler in color, while most oils become darker; at the same time the odor of the heated olive oil is pleasant, resembling strawberries, while the odor of the other oils is repulsive. *Schneider* (121) detects rape-seed oil by mixing with the suspected oil a solution of 0.1 gram of silver nitrate in a few drops of water, to which are added 4 cc. of alcohol; a brownish red to a black color appears after an hour or two, in the lower stratum of the liquid, or sooner if much rape oil is present; Provence oil, poppy oil, sesame oil and ground-nut oil remain unchanged. *Dietzsch* (29) applies the same test for cotton-seed oil, with the addition of heating the mixture to boiling for 15 minutes.

D. Spectroscopic tests.—Muller (97) gives the absorption spectra of olive and sesame oil, but nothing that will answer for a test of adulteration of olive with sesame or any other oil. *Nickels* (102) gives a spectroscopic test for the presence of cotton-seed oil in olive oil by a difference in the absorption bands in the red; but *Macagno* (87) shows that the test is unreliable.

E. Miscellaneous methods for testing olive oil.—Of these the most important and valuable is *Maumené's* (89) which depends on the elevation of temperature suffered by a certain quantity of oil when concentrated sulphuric acid of 66° B. is slowly added to it from a burette with constant stirring with the thermometer, and, at the same time, on the difference in the behavior of different oils with regard to the evolution of sulphurous acid. Olive oil gives a smaller elevation of temperature than any other oil with which it is commonly adulterated, and gives off so little sulphurous acid that there is no effervescence.

Maumené took 50 grams of oil and added 10 cc. of sulphuric acid; olive oil gave 42° C. elevation of temperature, and other oils from 52° to 103° C. *Fehling* (42) confirms Maumené's statements in the main, but observes that the rise of temperature depends upon the rapidity with which the acid is added, the strength of the acid, and the size and thickness of walls of the beaker in which the test is made, and the initial temperature of oil and acid. To save the consumption of oil he took only 15 grams, and 5 cc. of acid; but he acknowledges that more concordant results are obtained with larger quantities. He obtained but 38° rise of temperature with olive oil, and correspondingly lower results for the other oils; he gives the results with several mixtures of olive with other oils, showing that a small admixture of some of these oils can be detected by the greater elevation of temperature that follows the application of the test. *Allen* (1) obtained results agreeing pretty closely with Maumené's, and exactly the same for olive oil.

Next to this in general importance is *Tomlinson's* cohesion-figure test (129). When a drop of a fixed oil is gently deposited on a perfectly clean surface of water, which can be obtained only in a dish which has been rinsed with concentrated sulphuric acid, or better with a solution of potassium dichromate in the acid, a certain combination of figures and movements results from the struggle between the cohesion of the oil and the adhesion between the oil and water, which is characteristic for each kind of oil; and when one oil is mixed with another the resultant set of cohesion figures betrays by its character the kind of oil in the mixture, and by the predominance of the figures belonging to one oil, shows the predominance of that oil. Practical men engaged in the oil trade could successfully use the method after a little instruction; and one of them remarked to Mr. Tomlinson, after observing the figures, that "the oils wrote their names on the surface of the water." *Hallwachs* (55) meets with good success in the use of this test, using common spring water at 15° C. and glass dishes 10 to 26 cm. in diameter; he describes the figures which he obtained. *Craf* (26) also recommends the method.

Mailho (88) detects oils containing sulphur, such as colza oil, by boiling the sample with sodium hydrate and testing the alkaline liquid for sulphur with lead acetate; or the test may be made more expeditiously by stirring the boiling mixture with a silver spoon. *Renard* (113) tests for ground-nut oil by separating out the arachinic acid by saponification, fractional precipitation and recrystallization, and finally identifying it by its high melting point; but for this purpose much pains must be taken to get the acid in a tolerably pure condition. The test is made more easily, as given in Les Mondes (see Chem. News, 44, 1881, p. 216) by simply dissolving the fatty acids, obtained by saponification of the suspected oil with alcoholic alkaline solution, removing the alcohol by evaporation to dryness and decomposing the soap by hydrochloric acid, in boiling alcohol; on cooling the acid crystallizes out. *Buignet* (19) proposes to detect adulterations of olive with other oils by measuring the refracting power of the oil. *Coleman* (25) describes a method of distinguishing fatty oils from one another by differences in the viscosity, but without making any practical application of the principle to the detection of adulteration of olive oil.

For *poisonous metals* the oil is tested by shaking it up thoroughly with dilute nitric acid, drawing off the aqueous liquid from beneath

the oil after it has settled, and examining the solution in the usual manner for metals. *Cailetet* (20) tests for copper by adding 10 cc. of oil to a solution of pyrogallic acid in ether and shaking the mixture thoroughly; if copper is present the oil is colored brown, and cupric pyrogallate is precipitated.

A multitude of ways are given for detecting adulterations of olive oil; the lack is not in methods, but in respect to that assurance of the reliability of the methods which can come only from accumulated experience in the successful use of them by different analysts. Many of the reactions noticed in the preceding pages, especially the color reactions, depend for their manifestation on the presence of certain impurities associated with the glycerides in the crude oils, and which are more or less completely removed, as the oil is more or less carefully refined. Those who first describe the tests in many cases give us no information in regard to the quality of the oils used in establishing their tests; therefore we do not know how much dependence can be placed on the tests if carefully refined oils are used as adulterants; nor can we be sure that some of the reactions may not be given by poorly refined but unadulterated olive oil. Coleman in alluding to this feature of the subject shows that even refined oils of the same kind from different sources may give quite different color reactions. The simplest way to clear the path of all difficulties would be that which has been proposed in the case of milk, to declare that a good article of olive oil, fit for sale at good prices, shall stand certain tests.

The results of my own examination of olive oils.—I began with the test which has received the most testimony in its favor by analysts who have tried it, namely, Maumené's. My very first experiments gave results that enforced the importance of the careful regulation of the strength of the acid; for with acid of 65° B., or only a degree lower than that given by the author, the elevation of temperature was not in any case as great as given even for genuine olive oil, although it differed much for the different samples. On bringing my laboratory acid, which thus happened to be below the standard, exactly up to 66° B. or 1.84 sp. gr. by the addition of Nordhausen acid, which at the time was the most expeditious way of attaining the desired end, very decided results were obtained; but in every instance the rise of temperature exceeded 42°, sometimes by several degrees, even in the cases of oils which by most other tests applied appeared to be genuine olive oils.

I followed this test by others which seemed to promise to lead to some identification of the oils used in the adulteration that by the first test was quite clearly indicated in most of these samples; I sought especially to identify poppy, sesame, ground-nut and cotton-seed oils.

I received sixteen samples of oil, with the following numbers and trade designations; the price given is per 100 cubic centimetres. The numbers in black indicate samples that by my tests appeared to be genuine:

120. Huile d'Olive, superfine, clarifiée. Bordeaux.
121. Best Olive Oil.
224. Huile d'Olive, vierge. Nice. 6c.
225. Huile d'Olive des Gourmets, qualité extra fine. 15c.
226. Huile d'Olive, vierge d'Aix. 15c.
227. Huile d'Olive surfine, clarifiée double. Bordeaux. 8c.
228. Huile d'Olive, vierge. Nice. 7c.
229. Deutsches Extra S. Oel. Mohnoel. Sent by Inspector as olive oil. 15c.

230. Huile de Provence. 10c.
231. Huile d'Olive, surfine, deux fois clarifiée. 5c.
232. Huile d'Olive vierge d'Aix. Bordeaux. 5c.
247. Superfine Lucca Olive Oil. Leghorn. 16c.
248. Huile d'Olive vierge d'Aix. Bordeaux. 12c.
249. Huile d'Olive, surfine clarifiée. Bordeaux. 9c.
250. Huile d'Olive, vierge d'Aix. Bordeaux. 17c.
251. Huile d'Olive, superfine, doublement clarifiée. 17c.
3101. Huile d'Olive, vierge d'Aix. Bordeaux.

The results of my examination are set forth in the following table.

No. of Sample.	I. For Adulteration in General. To 15 gr. oil in small beaker, lower part jacketed with flannel, added dropwise 5 cc sulphuric acid 66 deg. Baumé, while stirring with a thermometer. Noted rise of temperature and evolution of sulphurous acid.	II. For Cotton Seed Oil. To 1 volume of oil added 1 volume nitric acid 40 deg. Baumé, mixed and let stand. Noted color taken by the oil.	III. For Poppy, Ground Nut and Sesame. To 5 volumes of oil added 1 volume nitric acid sp. gr. 1.33, mixed by shaking, and let stand. Noted, color of upper stratum or oil.
120	From 15 deg. to 58 deg., no effervescence with sulphurous acid	None	Light green.
121	From 26 deg. to 85 deg. and upwards. Much sulphurous acid	Coffee, lighter shade	Very red.
224	From 25 deg. to 95 deg. and upwards, abundant evolution of sulphurous acid, with effervescence	Coffee, dark shade	Reddish.
225	From 24 deg. to 73 deg., no effervescence	None	Light green, reddish tinge.
226	From 20 deg. to 68 deg., very little sulphurous acid	None	Light green.
227	From 25 deg. to 95 deg. and upwards, very abundant effervescence with sulphurous acid	Coffee, col. rather light	Reddish.
228	From 24 deg. to 95 deg. and upwards, very abundant evolution of sulphurous acid	Coffee, col. dark shade	Faint reddish.
229	From 25 deg. to 95 deg. and upwards, and much effervescence	Coffee, col. light	Quite reddish.
230	From 22.5 deg. to 90 deg. and above, some sulphurous acid	Coffee, col. dark shade	Faint reddish.
231	From 24.5 deg. to 95 deg. and upwards, very abundant effervescence with sulphurous acid	Coffee, col. rather light	Red.
232	From 21.5 deg. to 95 deg. and upwards, abundant evolution of sulphurous acid	Coffee, col. dark	Reddish.
247	From 25 5 deg. to 71 deg., no effervescence	No change	Light green.
248	From 26 deg. to 95 deg. and upwards, most abundant effervescence of sulphurous acid. Repeated: same result.	Coffee, col. rather light	Red.
249	From 21.5 deg. to 100 deg. and upwards, abundant effervescence, with sulphurous acid	Coffee, col. dark	Reddish.
250	From 24 deg. to 69 deg. and little sulphurous acid	No change	Clear greenish, very light.
251	From 24.5 deg. to 73 deg., little effervescence	No change	Light green.
3101	From 15 deg. to 60 deg., and no effervescence	No change	....
120	Repeated: 26 deg. to 72 deg., no effervescence	....	....

No. of Sample.	IV. For Poppy, Ground Nut and Sesame. To the 6 volumes of the preceding test, added 10 volumes solution sodium hydrate, mixed by shaking, and let stand. Noted — Color of upper stratum, and of liquid beneath.	V. For Poppy Oil. To 5 volumes of the oil, added 1 volume of mixture of concentrated nitric and muriatic acids, and then 10 volumes of sodium hydrate. Noted — Color of upper stratum, and of liquid beneath.	VI. For Sesame Oil. To 1 volume of the oil, added 1 volume of a mixture of equal parts of sulphuric and nitric acids, both concentrated, mixed, and let stand. Noted — Color of upper stratum immediately, and then later.
120..	Upper, yellowish white. Lower, no color..... .. .	Upper, rose color. Lower, no color.	First, yellowish. Later, deep red.
121 ...	Upper, reddish brown. Lower, very brown.	Upper, orange brown. Lower, orange brown...	First, deep green, boiled over.
224....	Upper, reddish. Lower, reddish.....	Upper, faint red. Lower, no color..........	First, nothing decided. Later, almost black.
225..	Upper, greenish. Lower, greenish..................	Upper, brownish. Lower, brownish............... .	First, little change. Later, deep red, thin transparent greenish layer at very top.
226...	Upper, greenish white. Lower, no color...	Upper, faint pink. Lower, no color..........	Same as above.
227 ..	Upper, pink. Lower, no color.	Upper, faint pinkish. Lower, no color.........	Same as 224.
228....	Upper, faint pink. Lower, no color.........	Upper, pink fibrous matter separating. Lower, colorless	Same as 224.
229 ...	Upper, brownish. Lower, brownish.	Upper, bright rose. Lower	Same as 224.
230 ..	Upper, faint pink. Lower, no color.................	Upper. fibrous pink particles separating out. Lower, colorless...	Same as 224.
231....	....	Upper, pinkish. Lower, colorless.	Same as 224.
232 .	Upper, pink fibrous, streaks more solid. Lower, colorless	Upper, with pink fibrous matter more solid. Lower, colorless.........	Same as 224.
247..	Upper, reddish. Lower, reddish.	Upper, brownish. Lower, colorless	Same as 225.
248....	Upper, pink. Lower, no color	Upper, fibrous, more solid particles floating. Lower, colorless............	Same as 224.
249....	Upper, pink. Lower, no color	Same as above............	Same as 224.
250..	Upper, greenish. Lower, no color.........	Upper, pinkish. Lower, no color	Same as 120.
251..	....	Upper, brownish. Lower, colorless	Same as 225.
3101	....	.. ..	... .

No. of Sample.	VII. For Ground Nut Oil. The oil saponified, soap decomposed by acid, and the fatty acids dissolved in boiling alcohol, and solution cooled. Noted — Whether crystallization of fatty acid took place.	VIII. For Cotton and Rape Oil. The oil was mixed with a solution of silver nitrate, containing alcohol, and boiled. Noted—Whether oil and liquid beneath colored brown.	IX. Condition of the oils on standing over night in room at about 3 deg. C.
120..	To small extent	No color....	Clear.
121....	To small extent	No color............	Some deposit.
224....	Very much	Somewhat colored........	Very much deposited, occupying nearly the whole volume of oil.
225..	To small extent............	No color.	Much deposited.
226 ..	To small extent	No color....................	Very heavy deposit.
227 ..	Very much indeed	Considerably colored......	Turbid throughout, fine deposit, not crystalized as others.
228 ...	Very much............. ...	Much colored........... ..	Very little deposit.
229....	To small extent	Somewhat colored.......	Clear.
230 ...	Very large deposit.........	Much colored....	Fine deposit throughout the liquid.
231....	Very large deposit..... ...	Somewhat colored.......	Clear.
232.. .	Very much..................	Very much colored........	Little deposit.
247..	To very small extent	No color......	Very much deposit.
248 ..	Very large deposit...	Very dark color indeed....	Clear.
249 ..	To small extent............	Much colored	Much deposit.
250...	None	No color............	Very little deposit.
251..	To very small extent.....	No color....	Very little.
3101.	....	No color...........	....

Conclusions.—The first and most prominent result obtained is that a majority of the oils tested are undoubtedly adulterated. The only oils that stood the first test (Maumeneé's) were Nos. 120, 225, 226, 247, 250, 251 and 3101, and in the tests that followed these oils behaved in most cases quite as described for pure olive oil, or else gave no clear reaction for any adulteration. These were in all cases the higher priced oils and those which appeared to be most adulterated were, with the singular and single exception of No. 229, which was labeled Mohnöl, cheap oils. Tests II and VIII taken together appear to indicate very plainly, by the deep brown color of the reaction, that Nos. 228, 230, 232 and 249 were adulterated with cotton-seed oil. Tests III, IV and VI gave most decided proof of sesame oil in No. 121, a sample procured by Mr. Colby, of a first-class druggists' firm in the city, at my request for a specimen of genuine oil for a standard of comparison. Instead of getting my standard of purity in that way, I have been obliged to select it from the whole number sent me, on cumulative evidence furnished by a variety of tests. No. 120, from the same firm, proved to be a genuine oil; this sample was sold in the original bottle, with foreign label, while the other, with only the label of the New York firm, appeared to be a sample of oil bought in bulk. The dark red or brown colors obtained in tests III, IV and V, gave strong indications of the presence of adulterating oils in most of the samples which did not stand the first test with concentrated sulphuric acid. Test V gave evidence of poppy oil in No. 229, by the bright rose color of the upper layer; on transcribing the trade labels on the bottles for the list of samples, p. 540), sometime after these tests were made, I found that this was labeled Mohnöl (poppy oil). According to Inspector Colby's label on the other side of the bottle, which was the only label that I examined, for the inspector's number when testing the oils, it was a sample of olive oil, and was sold to him as such; I had decided that it contained poppy oil, although supposing, till long afterwards, that it was claimed to be olive oil. From tests VII, Nos. 224, 227, 228, 230, 231, 232 and 248 appear to contain ground nut or pea nut oil; and as 228, 230 and 232 have already been noted as giving two characteristic reactions for cotton-seed oil, it must be concluded that both oils may be present. Test IX seems to show that if the indications of previous tests can be trusted, the behavior of the oil at low temperature has little value as a mark of purity; for the oils which by all other tests appear to be genuine, behave quite differently; and the presence of foreign oils, as indicated by previous tests, increases instead of diminishes the extent to which the oil solidifies. No. 229, however, the poppy oil, was found at a subsequent time to be quite clear at temperatures much below 3° C., which accords with the properties of the oil given in the books.

To sum up the whole matter, while there may not be in the results of these tests positive proof of the presence of this or that foreign oil in particular, there is fully sufficient proof of adulteration of some kind; and nothing more is required to convince me of the presence of *sesame* oil in 121, and little more is required to satisfy me as to the presence of *cotton-seed* oil in Nos, 228, 230, 232 and 249, of *ground-nut* oil in 227 and 231, and of one or both in 224 and 248.

Bibliography.

References have been made to the following works, in the progress of this report:—

1. Allen, The Analyst, 6, 1881, 102.
2. Ambuhl, Repertorium der Analytischen Chemie, 1, 1881, 171. Chemisches Centralblatt, 12, 1880, 475.
3. Ambuhl, Archiv für Pharmacie (3) 18, 293.
4. Angell, Proceedings of Society of Public Analysts, 1, 1876, 122.
5. Angell and Hehner, Butter, its analysis and adulteration (2d ed.), 1878.
6. Arnold, Mott, Brief History of the Megé Discovery, etc.
7. v. Babo, Landwirth. Correspondenzblatt, Grossherzogthum Baden, 1853, 65. Martiny, Die Milch; ihr Wesen und ihre Verwerthung, 1871. II. 195.
8. Bachmeyer, Dingler's Polytechnisches Journal, 226, 1877, 103.
9. Ballard, Chemical News, 4, 1861, 283, 322. Fresenius' Zeitschrift, 2, 1863, 100.
10. Barbot, Wurtz, Dictionnaire de Chimie, tome 2.
11. Behrens, Wurtz, Dictionnaire de Chimie, tome 2.
12. Bell, Journal of Royal Agricultural Society, 13, 1877, 181.
13. Birnbaum, Einfache Methoden zur Prüfung wichtiger Lebensmittel auf Verfalschung, 1877.
14. Blythe, Manual of Practical Chemistry. The Analysis of Foods and the Detection of Poisons, 1879.
15. Blythe. The Analyst, 5, 1880, 76.
16. Blythe, The Analyst, 3, 1878, 112.
17. Boudet. Wurtz, Dictionnaire de Chimie, tome 2.
18. Brown, Chemical News, 28, 1873, 39.
19. Buignet. Journal de Pharmacie (3), 40, 326.
20. Cailletet, Fresenius' Zeitschrift, 18, 1879, 628.
21. Cailletet, Guide pratique de l'essai des huiles.
22. Calvert, Annales de Chimie et de Physique, 42, 1854, 482. Philosophical Magazine (4), 7, 101. Journal für Praktische Chemie, 61, 1854, 354. Watts' Dictionary of Chemistry, vol. 4. Ure's Dictionary, vol. 3.
23. Chamber of Commerce of Nice, Annales de Génie Civil, 8, 1869, 146. Annales de Chimie et de Physique, 16, 1869, 308.
24. Chateau, Traité complet des Corps gras industriels.
25. Coleman, Chemical News, 29, 1874, 139.
26. Crauf, Kopp's Jahresbericht, 1874, 1038.
27. Crook, The Analyst, 4, 1879, 111. Dingler's Pol. Jour., 239, 1880, 150. Fresenius' Zeitschrift, 19, 1880, 369.
28. Dietzell and Kressner, Fresenius' Zeitschrift, 18, 1879, 83.
29. Dietzsch, Die wichtigsten Nahrungsmittel und Getränke; deren Verunreinigungen und Verfälschungen, 1879.
30. Dissel, Wurtz, Dictionnaire de Chimie, tome 2.
31. Donny, Journal d'Agriculture, Jan. 24, 1880. Milch-Zeitung, 9, 1880, 99.
32. Donny, Payen. Précis thèorique et pratique des Substances alimentaires, 1865. Fresenius' Zeitschrift, 3, 1864, 513.
33. Dragendorff, Archiv der Pharmacie (3), 12, 1881, 289.
34. Duffy, Proceedings Society of Public Analysts, 1, 1876, 168.
35. Duffy, Chemical News, 32, 1875, 27.
36. Duflos and Hirsch, Die wichtigsten Lebensbedürfnisse und ihre Aechtheit und Güte; ihre zufälligen Verunreinigungen und ihre absichtlichen Verfälschungen auf chemischem Wege erläutert, 1842. Martiny, Die Milch, ihr Wesen und Verwerthung. II. 197.

36a. Dumas, Traité de Chimie, 1830.

37. Dupre, The Analyst, 1, 1876-7, 114.
38. Dupre, The Analyst, 1, 1876-7, 89.

39. Elsner, Die Praxis des Nahrungsmittel-Chemikers, 1880.
40. English Public Analysts, Proceedings of Society of, 1, 1876, 185.
41. Estcourt, Chemical News, 35, 1876, 254.
42. Fehling, Dingler's Pol. Journal, 129, 1853, 53.
43. Fenner Committee, Testimony taken before Assembly Committee on Public Health in the matter of investigation into the subject of the manufacture and sale of oleomargarine butter and lard cheese, Hon. M. M. Fenner, chairman, 1881.
44. Filsinger, Pharmaceutische Centralhalle, 19, 260. Fresenius' Zeitschrift, 19, 1880, 236.
45. Filsinger, Chemiker Zeitung, 1878, Juni.
46. Fleischmann, Das Molkereiwesen, 1879.
47. Fleischmann and Vieth, Fresenius' Zeitschrift, 17, 1878, 287.
48. Flueckiger, Chemisches Centralblatt, 2, 1871, 55.
49. Fresenius, Fresenius' Zeitschrift, 18, 1879, 111.
50. Gatehouse, Chemical News, 32, 1875, 296.
51. Grandeau, Traité d'Analyse des Matières agricoles, 1877.
52. Griessmayer, Die Verfälschung der wichtigsten Nahrungs und Genussmittel, 1880.
52a. Gruber, Berichte der Chemischen Gesellschaft, 14, 1881, 2290. Zeitschrift für Biologie, 16, 195.
53. Hager, Pharmaceutische Centralhalle, 18, 413. Biedermann's Centralblatt für Agrikultur-Chemie, 5, 1876, 235. Fresenius' Zeitschrift, 19, 1880, 238.
54. Hager, Fresenius' Zeitschrift, 10, 1871, 234.
55. Hallwachs, Fresenius' Zeitschrift, 4, 1865, 252. Dingler's Pol. Journal, 174, 1864, 232.
56. Hassell, Food, its adulterations, and the methods for their detection, 1876.
57. Hauchecore, Fresenius' Zeitschrift, 2, 1863, 443.
58. Hehner, The Analyst, 4, 1879, 43.
59. Hehner, Fresenius' Zeitschrift, 16, 1877, 149.
60. Hehner and Angell, Fresenius' Zeitschrift, 16, 1877, 145. Chemical News, 32, 1875, 69.
61. Heydenreich, Wurtz, Dictionnaire, tome 2. Ure's Dictionary, vol. 2. Watt's Dictionary, vol. 4,
62. Heintz, Fresenius' Zeitschrift, 17, 1878, 160.
63. Heisch, Proceedings, Society of Public Analysts, 1, 1876, 125.
64. Hoorn, Maandblatt, 1870, 16. Chemisches Centralblatt, 2, 1871, 149 Fresenius' Zeitschrift, 11, 1872, 334.
65. Horsley, Chemical News, 4, 1861, 309, 322.
66. Horsley, Chemical News, 4, 1861, 230. Fresenius' Zeitschrift, 2, 1863, 100.
67. Hoskins, What we eat; an account of the most common adulterations of food and drink, 1861.
67a. Husemann, Handbuch der Toxicologie, 1862, und supplement, 1867.
68. Husson, Le lait, la crême, et le beurre, 1878.
69. Husson, Comptes-Rendus, 85, 1877, 718. Fresenius' Zeitschrift, 19, 1880, 236.
70. Jean, Journal d'Agriculture pratique, 43, 1879, 466.
71. Johanson, Pharmaceutische Zeitschrift für Russland, 20, 399. Chemisches Centralblatt, 12, 1881, 655.
72. Jones, The Analyst, 1, 1876-7, 19.
73. Jones, The Analyst, 4, 1879, 39.
74. Jones, The Analyst, 2, 1877-8, 19.
75. Kellner, Die landwirthschaftlichen Versuchs-Stationen, 25, 1880, 45. Fresenius' Zeitschrift, 19, 1880, 133.
75a. Kletzinsky, Dingler's Pol. Journal, 153, 1859, 407. Bulletin Société Chimique, 6, 1866, 427. Wurtz, Dictionnaire de Chimie, tome 1.

76. König, Industrie-Blätter, 1878, 15. Milch-Zeitung, 1879, 63. Chemisches Centralblatt, 10, 1879, 127. Fresenius' Zeitschrift, 18, 1879, 619.
77. Köttstorfer, Fresenius' Zeitschrift, 18, 1879, 199, 431.
78. Kopp, Kopp's Jahresbericht, 1875, 971.
79. Krätschmar, Berichte der Chemischen Gesellschaft, 10, 1877, 2091.
80. Kuleschoff, Bulletin Société Chimique, 29, 1878, 371.
81. Kunstman, Chemisches Centralblatt, 8, 1877, 319.
82. Lailler, Fresenius' Zeitschrift, 4, 1865, 255.
83. Lang, Die Fabrikation der Kunstbutter, Sparbutter und Butterine, 1878.
83a. Langlies, Fresenius' Zeitschrift, 9, 1870, 534.
84. Lechartier, Annales Agronomique, 1, 1875, 456. Biedermann's Centralblatt, 6, 1877, 146.
85. Lefebre, Wurtz, Dictionnaire deChimie, tome 2.
86. Leune and Harbulot, Journal d'Agriculture pratique, 1881, 85. Dingler's Pol. Journal, 240, 1881, 383.
86a. Liebermann, Anleitung zur Chemischen Untersuchung auf dem Gebiete der Medicinaplolizei, Hygiene und forensischen Praxis, 1877.
87. Macagno, Berichte der Chemischen Gesellschaft, 12, 1879, 1584.
88. Mailho, Comptes Rendus, 40, 1855, 1218.
89. Maumené, Comptes Rendus, 35, 1852, 572. Journal für praktische Chemie, 58, 1853, 26. Dingler's Pol. Jour., 126, 1852, 204.
90. Mayer, Milch-Zeitung, 10, 1881, 149. Fresenius' Zeitschrift, 20, 1881, 376.
91. Medicus, Gerichtlich-chemische Prüfung von Nahrungs und Genuss mitteln, 1881.
92. Medicus and Scherer, Fresenius' Zeitschrift, 19, 1880, 159.
93. Meissl, Dingler's Pol. Journal, 233, 1879, 329.
94. Michell, New York Times, 1878, June 27th.
95. Moser, Schleissche landwirthschaftliche Zeitung, 1875, 221. Biedermann's Centralblatt, 5, 1876, 478.
96. Mott, Brief History of the Megé Discovery. Oleomargarine Butter, or Butterine, 1880.
97. Mueller, Dingler's Pol. Journal, 198, 1870, 529.
98. Muter, The Analyst, 2, 1877–8, 25.
99. Muter, The Analyst, 1, 1876–7, 7.
100. Mylius, Correspondenz-Blatt des Vereins Analyt. Chemiker, 1, 1878, 34. Archiv der Pharmacie, 14, 1879, 69. Chemisches Centralblatt, 10, 1879, 558. Fresenius' Zeitschrift, 18, 1879, 111.
101. Nicklès, Bulletin, Société Indust. de Mulhouse, 36, 88. Dingler's Pol. Journal, 180, 1866, 392.
102. Nickels, Chemical News, 42, 1880, 1077.
103. Payen, Precis théorique et pratique des substances alimentaires, 1865
104. Penot, Wurtz, Dictionnaire de Chimie, tome 2.
105. Perkins, Journal Chemical Society, 1879, 1070. Fresenius' Zeitschrift, 19, 1880, 238.
106. Pfeifer, Biedermann's Centralblatt fuer Agrikultur-Chemie, 7, 1878, 864.
107. Piper, Western Rural, 1880, Feb. 14th.
108. Piper, Chicago Tribune, 1880, April 14th.
109. Pontet, Dumas, Chimie, T., 6, Wurtz, Dictionnaire, tome 2.
110. Redwood, The Analyst, 1, 1876–7, 51. Fresenius' Zeitschrift, 17, 1878, 510
111, Reichert, Fresenius' Zeitschrift, 18, 1879, 68.
112. Reichard, Archiv der Pharmacie, 13, 1878, heft 2.
113. Renard, Comptes Rendus, 73, 1871, 1330. Journal de Pharmacie et de Chimie, 15, 48. Fresenius' Zeitschrift, 12, 1873, 231.

114. Reynolds, Fresenius' Zeitschrift, 5, 1866, 252.
115. Roster, Berichte der Chemischen Gesellschaft, 13, 1880, 580. Fresenius' Zeitschrift, 19, 1880, 477.
116. Roth, Kopp's Jahresbericht, 1865, 741.
117. Rubner, Zeitschrift fuer Biologie, 15, 1879, 115. Biedermann's Centralblatt, 10, 1881, 394.
118. Ruedorff, Poggendorf's Annalen, 145, 1872, 279.
119. Sacchse, Fresenius' Zeitschrift, 17, 1878, 151.
120. Scheibe, Pharm. Zeitschrift für Russland, 1881, 431. Chemisches Centralblatt, 12, 1881, 703.
121. Schneider, Polytechnisches Centralblatt, 1861, 1229. Chemisches Centralblatt, 6, 1861, 750. Kopp's Jahresbericht, 1861, 875.
122. Sestini, Fresenius' Zeitschrift, 6, 1867, 362.
123. Smart, Bulletin, National Board of Health, supplement No. 11.
124. de la Souchere, Moniteur Scientifique, 1881, 790, Chemical News, 44, 1881, 216.
125. Stillurell, Chemisches Centralblatt, 4, 1873, 799.
126. Storch, Ukeskrift for Landmaend, 1881, 20. Milch Zeitung, 10,-1881, 609.
127. Taylor, American Quarterly Microscopical Journal, 1, 1879, 294.
128. Taylor, Scientific American, 38, 1878, 374.
129. Tomlinson, The Engineer (London), 1864, 138. Zeitschrift der Architecten-und Ingenieur-Vereins fuer Hannover, 12, 1866, 150.
130. Tripe, Proceedings Society Public Analysts, 1, 1876, 119.
131. Van der Burg, Fresenius' Zeitschrift, 4, 1865, 276.
131a. Voelcker, Journal of Royal Agricultural Society, 23, 1862, 346.
132. Walz, American Chemist, 4, 1873, 169.
133. West-Knight, The Analyst, 5, 1880, 155. Fresenius' Zeitschrift, 20, 1881, 466.
134. Wideman, Berichte der Chemischen Gesellschaft, 12, 1879, 1585.
135. Wigner, The Analyst, 1, 1876–7, 145
136. Wimmel, Poggendorft's Annalen, 133, 1868, 121. Dingler's Pol. Journal, 188, 1868, 421.
137. Wimmel, Poggensdorff's Annalen, 142, 1871, 471. Dingler's Pol Journal, 200, 1871, 494.
138. Wittmach, Milch-Zeitung, 8, 1871, 67. Fleischmann, Das Molkerei wesen.
139. Wunzel, Berichte der Chemischen Gesellschaft, 14, 1881, 1125. Repertorium der Analyt. Chemie, 1, 1881, 172.
140. Wurtz, Dictionnaire de Chimie, tome 2.

GROUP III.

CANNED MEATS AND ANIMAL FOODS: MEATS—FRESH, SMOKED, SALTED, CANNED; EXTRACTS AND ESSENCES OF MEAT AND FISH; GELATIN AND ISINGLASS.

BY ALBERT H. CHESTER, PH. D.

Prof. C. F. CHANDLER, Ph. D.,

Chairman Sanitary Committee:

My Dear Sir:—I take pleasure in submitting to you herewith my report, as one of the chemists under the Food and Drug Act, on Canned Meats and Animal Foods.

Yours very respectfully,
ALBERT H. CHESTER, Ph. D.,
Professor of Chemistry.

HAMILTON COLLEGE,
CLINTON, N. Y., *Dec.* 3, 1881.

The use of animal food is so closely connected with physical force that it is a matter of vital importance to the welfare of any nation that its people should be supplied with cheap and wholesome meat. There can be no question that the physical superiority of the English over Continential nations is due in great part to the roast beef and mutton that have been so freely consumed in Great Britain. While life may be sustained and much work accomplished without any animal food at all, yet it is an acknowledged fact that severe bodily exertion cannot be sustained without it. This is recognized in the difference made in the diet of prisoners, depending on whether they are at hard labor or not. It is found that while milk, butter and cheese will be great additions to an otherwise purely vegetable diet, meat is the great work-producing agent. We are very fortunate here in this respect, and the poorest of our people can have meat every day of their lives and still a surplus be left to be sent abroad to feed people who would otherwise have to do without it. American lard, pork, and hams are supplied in all the European markets, and beef from this country is used to a large extent in Great Britain, all being sold cheaper than the home products. The great value of our exports of this class of food to some of the countries of Europe is shown by the following extract from a speech of M. Graux, the Belgian Minister of Finance. He is arguing against the imposition of a duty on meat preserves, and says:

"To stop these importations would be to devote the working classes (of Belgium) to misery, if not to death; to obstruct their entry by means of customs-duties would be to impose on the masses prices which would only benefit the land-owners. It is thus that some amongst us, in order to protect the agricultural interests of the country and prevent the owners of agricultural lands from suffering that reduction of their rents which the common and universal law of supply and demand imposes, would have us, by stopping these importations, make a compact with famine and deliver our industrial and laboring classes to misery, decline and ruin."

Fresh meat is, undoubtedly, the most important and valuable kind of animal food, as either salting or smoking it makes it less easily digestible. It is important that the animals should be properly killed, and the blood allowed to escape afterwards, and that the meat should be delivered to the customers in a sound condition; though meat is always better if it has been kept awhile before it is cooked, even nearly to the point of decomposition. The fibre of such meat is loose and tender and much more digestible. The best meat is from animals that have been fattened before being killed. The muscle of unfattened cattle contains about seventy-five per cent of water, with only two or three per cent of fat, while the flesh of fat cattle is marbled and streaked with fat which has to a certain extent taken the place of the water, and hence is much more valuable as food.

Sound healthy meat can be recognized by its pale reddish color when first cut, the surface afterwards turning to a deep red color. The meat of animals that have died is of a deep purple color, not having been bled. Such meat often has an unpleasant odor, which healthy meat has not until it begins to decompose. Putrid meat may often be recognized by its odor, or by thrusting a knife into it. In healthy meat the resistance to the knife will be uniform while it will vary if it has begun to putrify within. The smell of the knife often affords useful information. There is not much danger from this kind of meat, for the customer himself will detect and refuse it. It is not so however with certain diseases of the flesh and the infection caused by parasites, which can only be detected by tne use of the microscope, and public inspectors must be very vigilant to protect the people. This matter is one of great importance in cities, and is generally carefully looked after by local Boards of Health. The most common and dangerous of these affections is the presence of trichinæ in pork.

TRICHINÆ.

The vast importance of the production of pork for home consumption and for export makes it desirable to give more than a passing glance at this part of the subject. Pigs are so easily fattened and the pork is so readily cured and preserved that it will always be one of the chief products of certain parts of the country. And it is no doubt a most useful food particularly for the mass of working people and in the winter. Many people hardly see fresh meat the year around, but consume great quantities of salt pork and smoked ham. Our exports of such food material is immense and constantly increasing. It is so cheap here that it can be sent to European markets and compete with their home products, so that the German peasant is to-day buying American pork and hams. But the fear that these American products may contain the pork worm, Trichina spiralis, is causing many of the European states to pass stringent regulations with reference to the admission of our products of this character, even including lard, in which certainly trichinæ cannot be found. Thus great damage is being done to our export trade. That this fear is not unfounded is too evident from the examinations made in Chicago by Mr. Attwood, who found trichinæ in eight per cent of the hogs killed in that city. There have been many cases of the disease, trichinosis, often ending in death, as the result of eating such meat. We have then two evils to guard against, the danger to ourselves if trichinous meat is used, and the damage to our trade

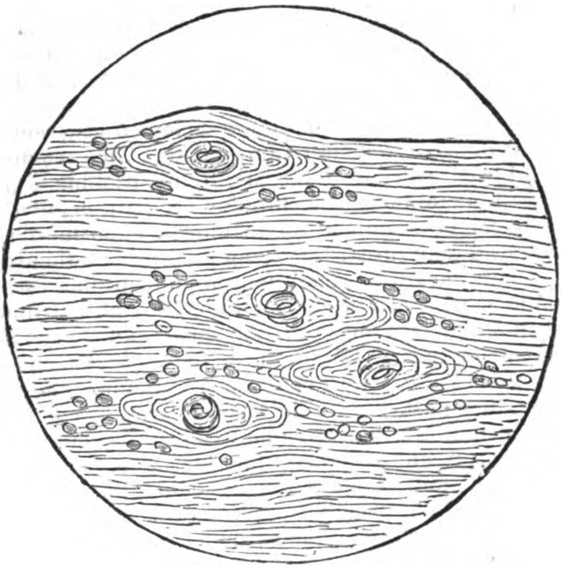
abroad if we do not suppress the exportation of such meat. Consul Byers thus writes to the State Department from Zurich, Switzerland, showing the condition of things in that country. "There exists a Government order dated May 17, 1878, forbidding the importation of hams, bacon, etc., whether from America or elsewhere, unless said importation is accompanied by a certificate showing that the meat is 'healthy'. If no such certificate is presented, the meat must be submitted to a microscopic examination for 'trichinosis'. This certificate is charged for at the rate of about 25 cents a ham. The practice has been to be especially severe in the execution of this order as to American hams, as certain interested parties have frightened the population into the belief that eating American hams is simply to court death. The result is that American hams can scarcely be sold here at all, or if sold the dreaded word 'American' is left off, and the meat is offered as coming from Germany."

Privy Councillor Ruloff in a recent lecture before the National Health Association, at Berlin, spoke as follows: "It is well-known that trichina is of frequent occurrence in America, therefore sausage, bacon and hams produced there must be considered as very dangerous. Inspections at various points show that from one to four per cent of these preserves contain trichinae. As may be easily foreseen, trichinæ will increase in America unless steps are taken to prevent it."

We must therefore adopt measures to prevent the exportation of any such meat, and to prevent the further spread of the disease in the hogs raised in this country, if not to root it out altogether. For the first result it will probably be necessary to have every lot of bacon and ham, packed for shipment abroad, inspected for trichinae by officers appointed for the purpose, their certificates to be sent with the articles. Consul Byers is of the opinion that such certificates would be respected all over Europe, and that much of the prejudice now existing would be removed. For ourselves in this country, the danger is not so great, for we seldom eat our meat raw, as is so frequently the case abroad. And yet none of us wish to take the chances of trichinous meat even though we know it to be well cooked. Thorough cooking will certainly kill trichinæ, and we may rest easy as to danger from that source, if we only see to it that all the pork we eat has in all its parts been subjected to a temperature of at least 160 deg. Fahrenheit. It should be well understood that pork should never be eaten raw unless it has been carefully examined, and that the cooking must be thorough, and not a mere warming of the surface, if the probable trichinæ are to be killed. It is to be noticed that this parasite is seldom found in the home grown pigs generally eaten in the county. I have never found any in the ham and pork offered for sale in this village. It is in the large fattening establishments where meat is produced in immense quantities for sale in cities and for export, that it is most often found.

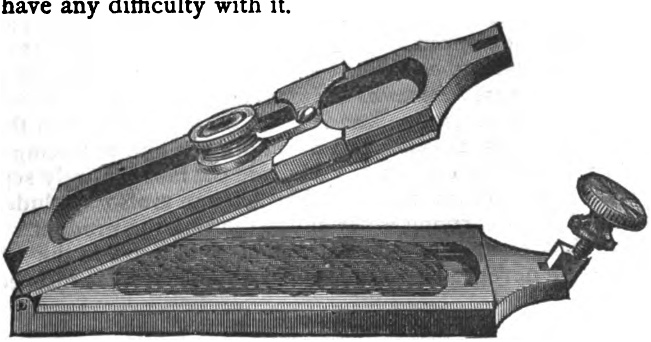
Before looking for the means of protection from this pest, let us see how it is to be detected. The Trichina spiralis is a minute worm found coiled up in animal muscle, particularly in the flesh of swine, not, however, to be certainly distinguished by the naked eye, though such pork often has a speckled appearance. An examination with the microscope is necessary to reveal it in its coiled up form. The worm itself is enclosed in a little sac or cyst covered with a calcareous

deposit, which effectually prevents further motion, although the inmate is still alive.



The above figure, taken from Dr. John Phin's little pamphlet on trichinæ shows the appearance of the worms in the encysted form. When meat is eaten containing these encysted worms, the gastric juice dissolves the coating of lime, and the worm is set free to roam at will through the muscles of his entertainer, be it man or beast, and to reproduce his own kind in myriads. They cause sickness and death if in sufficient numbers, but if this result is not reached, they soon become encysted in their new home, after which they are powerless for harm.

A magnifying power of about fifteen diameters will easily serve for their detection, and the best instrument is of course the compound microscope in the hands of an expert; yet this is not necessary, for I have seen them distinctly with an ordinary hand magnifier having a power of only nine diameters. The best simple instrument that I have seen for this purpose, is the one figured in the cut below, called a trichinoscope, and recently devised by the Bausch & Lomb Optical Co., of Rochester. It is so easily used that no one of ordinary intelligence could have any difficulty with it.



Two glass slips are held in hinged frames with a screw clamp at one end, so that they can be brought together and pressure applied to any object placed between them. A good doublet, magnifying about fifteen diameters, is so arranged that it can be accurately focussed, and it is movable over the whole surface of the glass. The thin slice of flesh to be tested is if possible soaked in acetic acid for a few minutes, though this is not absolutely necessary, and then spread out on one of the slips of glass. The other is brought down on it and clamped fast, enough pressure being applied to make the flesh transparent. The magnifier has then only to be adjusted when it will be easy to find trichinæ if present. They are more apt to be found in certain muscles than in others, and if the whole animal can be examined the diaphragm is the muscle to choose, or those of the head and throat. The muscles around the eye often show them, and I have heard it stated by a prominent microscopist that he never examined any cat's eyelid in which he did not find them. In testing a ham a thin shaving from the small end as near the tendon as possible should be taken. With one of these instruments, which costs but a trifle, it is easy for any one to detect trichinæ, and every butcher may examine the pigs he buys if he wishes. And if a fine is imposed on every one detected in selling trichinous meat, the butcher will want to be able to detect it, and so protect himself. The law should be stringent on this point, and should specially define this kind of material as dangerous to the public health. Such a law well enforced, would by degrees root out the evil, and our fattening establishments would be so arranged that healthy animals could not become infected. This is a most important point and should be guarded against very carefully. In the large establishments, and the smaller ones, too, the offal is much of it fed to the pigs so that if the disease once makes a beginning it is carried on from one set of pigs to another as fast as they arrive. The remedy is to keep such material in iron boxes safe from cats and rats and to cook it thoroughly before it is used for any purpose, either for feeding pigs or for the manufacture of fertilizers. If every one who sells trichinous meat is liable to be fined, the means for destroying the pest will be sought by every one interested, and the final result will be its entire destruction

Meat Extracts.

Since the discovery by Baron Liebig, in 1857, of the extract which bears his name, a great number of such preparations have been put on the market mainly for the use of invalids, their value depending on how nearly they approach the original in composition. Extract of meat, when properly made, consists of those constituents of flesh which are soluble in hot water; the solution having been evaporated as much as possible for convenience in transportation. These soluble parts of meat include a number of obscure chemical substances, the value of which have not been accurately ascertained, and certain salts also found in the meat. The proteids, such as albumen and fibrin are left out, not being soluble in hot water, and if the extract is well made the fat is entirely separated having a tendency to turn rancid. The gelatine is also excluded as a useless incumbrance carrying water and so diluting the product.

The materials composing the extract are not food in the ordinary sense and ought never to be allowed to take its place, as is insisted upon

by Liebig in all his articles on the subject. It is useful both as a nerve stimulant, and as an adjunct to food proper. There are too many recorded cases of its usefulness in the first respect for any candid person to doubt it. It takes the place of alcoholic stimulant, and is often used in cases of extreme nervous exhaustion and prostration. It is of great value in the sick-room in cases of fever when true food cannot be given and it is necessary to stimulate the vital forces. It is really nothing more or less than a concentrated form of the best beef tea and no one doubts the value of that. Yet there is a popular impression that ordinary beef tea is food, and many invalids are starved upon it when they ought to be nourished. Let it be distinctly understood that beef extract, and equally beef tea, is not food if used alone. It is only a stimulant, and resembles tea and coffee in its effects. The nourishing parts of the meat have all been left out, and always will be when it is made with hot water. If beef juice is to be used as nourishment rather than stimulant it should be extracted with cold water, the addition of a few drops of chlorhydric acid aiding much in the operation. Beef extracts contain part of the valuable constituents of the meat. If the muscle-producing parts were added you would then have true meat food. It is found however that these constituents, the albuminoids, can be added in the form of vegetable products, while the extractive matters can only be obtained from meat. This is Liebig's claim and it seems to be borne out by all the facts His belief was strong that the most valuable part of the meat is the extractive matter since it cannot be obtained from any other source, hence his formula aims to leave out everything else. It is said by some however, that an extract would be more valuable if it contained in addition the other parts of the meat and was in fact condensed meat. It is therefore claimed for some of the extracts sold that they contain all the valuable constituents of meat in a concentrated form and are therefore true food, consequently of far greater value than Liebig's Extract, much greater in fact than the amount of meat they are said to represent. I have tested a number of these extracts with the results given below.

No. 1. Liebig's Extract.

It is packed in a small earthen jar containing about 50 grams of a brown paste and costs 50 cents.

Water	18.27	per cent.
Organic matter	58.48	"
Ash	23.25	"
Soluble albumen	0.05	"
Alcoholic extract	44.11	"

No. 2. Berger's Extract of Beef.

Package, or tin can containing 58 grams of a yellowish jelly, quite stiff. Price 28 cents.

Water	40.65	per cent.
Organic matter	39.85	"
Ash	19.50	"
Soluble albumen	1.11	"
Alcoholic extract	13.18	"

No. 3. Starr's Extract of Beef.

Package, a tin can containing 130 grams of extract quite similar to No. 2. Price 60 cents.

Water	37.00	per cent.
Organic matter	55.65	"
Ash	7.35	"
Soluble albumen	1.10	"
Alcoholic extract	10.13	"

No. 4. Johnston's Fluid Beef.

Package, a tin can containing 60 grams of a stiff yellow paste. Price 35 cents.

Water	41.20	per cent.
Organic matter	50.40	"
Ash	8.40	"
Soluble albumen	1.17	"
Alcoholic extract	15.93	"

No. 5. Guant's Beef Peptone.

Package, a corked bottle containing about 105 grams of a molasses-like substance. Price 50 cents.

Water	37.15	per cent.
Organic matter	54.92	"
Ash	7.93	"
Soluble albumen	0.00	"
Alcoholic extract	20.16	"

No. 6. Valentine's Meat Juice.

Package, a corked bottle containing 83 grams of a thin dark colored fluid. Price 75 cents.

Water	54.40	"
Organic matter	31.85	"
Ash	13.75	"
Soluble albumen	0.44	"
Alcoholic extract	26.32	"

No. 7. London Co.'s Extract of Beef.

Package, a tin-can containing about 50 grams of a thin honey colored extract. Price 30 cents.

Water	81.90	per cent.
Organic matter	16.80	"
Ash	1.30	"

No. 8. London Co.'s Essence of Mutton.

Package, same as last but containing 60 grams extract. Price 50 cents.

Water	78.00	per cent.
Organic matter	19.50	"
Ash	2.50	"

No. 9. London Co.'s Essence of Chicken.

Package, same as last but twice as large, containing 112 grams of extract. Price 75 cents.

Water	71.60	per cent.
Organic matter	27.10	"
Ash	1.30	"

Putting the above figures into a tabulated form for convenience of reference we have the following.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Water	18.27	40.65	37.00	41.20	37.15	54.40	81.90	78.00	71 60
Organic matter	58.48	39.85	55.65	50.40	54.92	31.85	16.80	19.50	27.10
Ash	23.25	19.50	7.35	8.40	7.93	13.75	1.30	2.50	1.30
Soluble albumin	0.05	1.11	1.10	1.17	0.00	0.44	......	......	.....
Alcoholic extract	44.11	13.18	10.13	15.93	20.16	26.32	......	......	.....

The albumen was determined by treating the extract with tepid water, the solution obtained being heated in a water bath for some time with the addition of a few drops of acetic acid. Numbers 2 and 3 contain a large amount of gelatine. Number 4 contains a considerable amount of meat fibre in a very finely divided condition. Numbers 7, 8 and 9 are evidently just what they claim to be, extracts in hot water, much less concentrated than the others, and containing nothing to preserve them. They therefore spoil soon after being opened and exposed to the air. The percentage of the extracts taken up by strong alcohol, is I think the most important matter in the examination, and it is here that the poorer extracts will be found to fail.

From these analyses it will be seen that the principal difference between them is the amount of water that they contain, and in some cases there is a large amount of gelatine, useful in making soup, but not considered of great value as food. It is evident that the claim of making an extract equal in all respects to fresh meat has not been carried out, and to use any of them as the sole food of an invalid would be a great mistake.

I do not find any evidence of adulteration in the extracts examined, unless the presence of gelatine, and an undue amount of water can be so considered; but I do find that the claims of the makers on their labels are not substantiated, and I am forced to believe that there is no extract in which soluble albuminous substances are found to any extent.

Besides the various extracts of meat, there are in the market many extracts of fish some of which are of considerable value. They are of the same character as meat extracts, according to Dr. Letheby, but not so pleasant in taste or of as great value. I have not been able to obtain any of them for examination.

As has been stated Liebig insisted that while this extract is not in itself food it is an essential ingredient of food, obtainable from no other source, and if mixed with albuminous and starchy matter, will give the best food at a cheap rate. Acting on this suggestion various forms of meat biscuits have been prepared, and a very concentrated form of

nourishment is thus obtained, useful in circumstances where fresh meat cannot be had, as in Arctic voyages. While the absurd claims of the manufacturers of such material cannot be substantiated, these preparations are, to say the least, of considerable value, and would be more used if their merits were better known. In most cases, however, it will be cheaper and more convenient to carry the extract by itself and eat it with bread or mix it in soup as wanted.

Meat Preserves.

There are three principal methods of preserving meat, by salting, smoking and canning. The first two methods do not add any thing of a dangerous character to the meat, neither do they efficiently destroy any danger that may be hidden in it. Meat, unwholesome before, will not be wholesome after such treatment. Trichinæ will not be killed, and it is in meat so prepared that we will most often find this pest. But in canning meat there is the added chance that poisonous metallic impurities may get in by accident as well as that other substances may be put in by design as adulterations. All kinds of meat are now put up in tin cans for preservation and easy transportation, so that we may buy in our own market beef from South America, buffalo tongues from the Western prairies and Kangaroo tails from Australia.

The packages most likely to be adulterated are the expensive potted and spiced meats and fish used generally as relishes. In these, as Dr. Hassall tells us, may often be found flour, chalk, plaster of Paris, Venetian red, and Armenian bole, a sort of red clay. But these matters do not concern the public to any great extent, and I have confined my attention to those canned meats that are largely used as food in this country. Among these we find canned beef, mutton, ham, tongue, turkey, chicken and corned beef, the last more used than all the rest together. These materials are very extensively prepared and packed and are used by people who can not readily obtain fresh meat. Many cases have been reported in the papers where it is alleged that persons have been poisoned by the use of such meat. I have never been able to obtain a sample of the meat which had produced such a result, nor have I seen any authentic report of a chemical examination of such meat, showing the kind of poison. It has been said that lead from the solder is liable to be found in the meat, and sometimes this may be the case, although I do not believe the danger from this source to be great. To meet this difficulty some manufacturers do not use lead solder at all. There is more danger when the cans are made of teme plate, containing lead, instead of pure tin plate. Teme plate should never be used in canning goods for use as food, for the lead is very liable to get into the food. If good tin-plate free from lead is used, and the soldering is properly done no one need fear lead poisoning from this source, although so much has been said about it that many people are afraid to use eatables of any kind put up in tin. Recently another view of the subject has been promulgated by Mr. Otto Heyner, of London, who says that nearly all canned meats and vegetables dissolve tin from the cans and are dangerous to use in consequence. He says that tin in the stanuous form as it will be if so dissolved is a "virulent irritant poison," proving this statement by citing experiments conducted by himself on some Guinea pigs and concluding his report as follows:

"I trust that the medical profession wlll object, unmistakably and strongly, to the administration of tin by grocers and oilmen to young and old alike, and, whilst acknowledging the enormous benefits conferred upon the masses by the introduction of preserved foods, will insist that the present system of packing be speedily abandoned." This is a very sweeping denunciation of tin cans, and if his statements are correct we must condemn all tinned goods as dangerous, and prohibited under the act to prevent the adulteration of food and drugs. There is one fact however that will make it difficult to believe these assertions, at least as far as goods packed for sale in our own country are concerned. Many people in the west, particularly in mining and lumber camps, eat food so preserved every day of their lives, and do not suffer in consequence. In my own experience I have had gangs of men at work in the woods for months at a time eating canned corned beef, tomatoes, corn, peaches and condensed milk every day without a single case of sickness of any kind during the season. If there is always tin in such food it cannot be a very "virulent" poison.

Glass is a safer material for cans, and the method recently patented by Mr. Edison for preserving perishable articles of food in glass vessels promises good results, as there is no chance for contamination of any kind. But the great objection to this method is the danger of breakage which will prevent it from ever taking the place of tin completely. That packages of beef will keep well when properly put up is shown by the following fact. In the summer of 1875, while going with a party through the woods of Northern Minnesota, some cans of corned beef were hidden under a stump, to be used on our return. We came back by another route, and did not use it at that time. Though some of us passed that way afterward it was not again thought of until the summer of 1880 when it was sought and found just as it had been left. The cans were opened and the meat eaten, being perfectly sweet and good, though exposed to the alternations of a Minnesota climate for five successive summers and winters. Glass cans would probably have been broken by freezing the first winter.

The worst thing that can be said about these canned goods is that the quality of the meat is not the best, perhaps sometimes not even good. The scraps and bits that formerly went into the manufacture of fertilizers are undoubtedly often used up in this way, and the canned meat therefore represents the very poorest parts of the animals. In the case of beef there may be no great objection to this, for the meat is thoroughly cooked and always sufficiently tender. Canned ham and pork should however be always carefully looked over for trichinæ, which are most often found in the poor parts that would probably be selected for canning. Spoiled and putrid meat could hardly be used for this purpose without detection, and I have only seen one instance of it in any of the cans that I have examined, and this was indicated before opening the can by its bulged appearance. I could not tell of course whether it was tainted meat to begin with, or had spoiled after canning through some defect in the process. I found no metallic poisons in any of the canned meats examined.

Isinglass and Gelatine.

These similar animal preparations are used extensively in the manufacture of jellies and soups, and in clarifying liquors. Isinglass is made from the swimming bladders of fish, while gelatine is prepared from the skin and bones of animals. They are identical in composition and uses, but the isinglass is decidedly the finer and more expensive product and therefore gelatine is often substituted for it in whole or in part. Isinglass is more soluble in water than gelatine and makes a clearer and better jelly, and is said not to be so apt to disagree with the delicate stomach of an invalid. It has a slightly fishy smell though not an unpleasant one, while gelatine has more or less the smell of glue. The four samples I was able to obtain in market here were two of them sold for isinglass and two for gelatine, but all turned out to be samples of gelatine, those sold as such being of better quality and rather more expensive than those called isinglass. There is a decided lack of knowledge with respect to these materials in this country. The English are better posted, and would not buy common gelatine smelling like glue when warmed in water, under the name of isinglass. It would be well to have this adulteration or substitution distinctly specified as against the law. The gelatines examined were found to be of very good quality and free from adulterations.

Hamilton College Laboratory,
December 3, 1881.

BIBLIOGRAPHY.

The American Chemist.
The Chemical News.
Science.
U. S. Consular Report.
Trichinæ and Trichinosis, by Dr. W. C. W. Glazier.
Trichinæ, by John Phin.
Johnson's Cyclopœdia.
Watts' Dictionary of Chemistry.
Miller's Chemistry.
Fowne's Chemistry.
Blyth's Chemistry.
Hassall's Adulterations of Food.
On Food, by Letheby.
Meat Extracts, by A. L. Beebe, Ph. B.
Extractum Carnis, by A. P. Hallock, Ph. B.

Group IV.

Cereals, and the products and accessories of Flour and Bread Foods; Wheat; Rye; Barley; Rice; Oat-meal; Corn-meal; Sago; Tapioca; and Leguminous preparations; Special Artificial Foods for Infants and Invalids; Baking Powders; Cream Tartars; Bicarbonate of Soda; Bicarbonate of Ammonia; Alum Powders and the "Alum Question".

By E. G. Love, Ph. D.

New York, *December* 31, 1881.

Prof. C. F. Chandler,

Chairman Sanitary Committee State Board of Health :

Sir — I have the honor to submit the following report on the group of foods assigned to me for examination. It includes the cereals and their products, flour, bread, baking powder, etc. I have examined in all 283 samples, of which thirty-seven only were adulterated.

Very respectfully,

E. G. LOVE, Ph. D.

In the following report I have endeavored to present, in as concise a manner as possible, the results of my examination of the samples submitted to me. These examinations, having for their specified object the collecting of information concerning the extent to which food and drug adulteration is practiced in this State, and moreover as the time allowed for the investigation was necessarily limited, those articles of food of this group were first examined which were considered most likely to be adulterated, and the many interesting questions which presented themselves during the work were made of secondary importance. For this reason the subject of "Infant Foods" is not considered in the following pages. Previous examinations had proved to my own satisfaction that they were not subject to adulteration, and the question of their dietetic value, while of great importance, was considered somewhat foreign to the present investigation. I should have included them, however, had there been sufficient time.

As to methods of examination, the microscope was mainly depended upon for the detection of foreign matter of a purely vegetable nature, while for the inorganic adulterants the simple methods of the laboratory were employed.

I have considered the "alum question" at some length, inasmuch as the very general use of alum baking powders in this country made it desirable to ascertain the prevalent opinion of chemists and physiologists regarding the wholesomeness of such preparations.

Bakers' Chemicals.

Saleratus.— The term saleratus was originally applied to bicarbonate of potash and previous to the introduction of baking powders was in common use in the kitchen. Its greater cost however has led to the substitution for it of the much cheaper compound bicarbonate of

soda, and at present none of the saleratus sold by grocers contains the potash salt. This substitution cannot, however, be considered as an adulteration, inasmuch as there is nothing necessarily restricting the name saleratus to the bicarbonate of potash, and so long as the commercial article is sold at the price of the soda compound there is no evidence of intention to defraud.

I have examined twenty samples of saleratus submitted to me, and in every case they consisted of bicarbonate of soda without foreign matter other than that always found in the commercial article. The samples were put up and sold in paper packages, and in most cases were marked with the manufacturer's name. The sale of such articles in bulk and with no name attached is always objectionable as offering greater facilities for adulteration.

Baking Soda.— This is the commercial bicarbonate of soda, which as such is employed in cooking, and also forms one of the active ingredients of baking powder. Of the twenty-three samples examined only three were adulterated. One with terra alba or ground gypsum, to the extent of about twenty-five per cent ; another with about the same amount of gypsum in addition to a small quantity of starch ; and the third with a large amount of sulphate of soda and about seventeen per cent. of carbonate of lime. On account of its cheapness there is little temptation to adulterate baking soda. It should be remarked that every commercial bicarbonate of soda contains small amounts of the sulphate and chloride of sodium as impurity in its manufacture. As these impurities are in no way injurious, in the small quantity in which they exist, and as a chemically pure article would be expensive, no special objection can be raised to their presence. It is interesting, however, to know to what extent these impurities exist, and the following table gives the results of some analyses to ascertain the amount of sulphate of soda present in common baking soda.

1.	Percentage of anhydrous sulphate of soda	2.22
2.	" " "	1.22
3.	" " "	1.92
4.	" " "	0.98
5.	" " "	1.11
6.	" " "	1.05
7.	" " "	0.88
8.	" " "	1.09

A number of samples of baking soda were examined for the purpose of determining the amount of alumina which might be present as an impurity in the process of manufacture. While traces were present in all cases, the amount was too small to admit of weighing.

Cream of Tartar.— This is the acid or bi-tartrate of potassium, and is used both in medicine and in culinary preparations. Its comparatively high price renders it an article of very general adulteration. Of the twenty-seven samples examined, sixteen were adulterated and in some cases not a particle of cream of tartar was to be found. Six samples were adulterated with terra alba and starch, one with starch alone, and two with starch, terra alba and acid phosphate of calcium. In six samples tartaric acid had been substituted for cream of tartar and in each case the sample was otherwise adulterated. Tartaric acid possesses

greater acidity than the acid tartrate of potash and hence its substitution allows the addition of more foreign matter and at the same time the maintaining of a certain degree of acidity. In eight samples the amount of terra alba was determined and found to range from 3.27 to 93 per cent. Five samples contained over 70 per cent. of this adulteration.

Cream of tartar, unless chemically pure, contains a certain amount of tartrate of lime as an impurity. This compound is not injurious, but of course diminishes the value of the salt by introducing so much inert matter. So far as I am aware, no limit to this impurity has been fixed, even in its use medicinally, although there seems to be no reason for not establishing some limit. The amount of tartrate of lime in commercial cream of tartar varies from two to fifteen per cent., but six or seven per cent. may be considered as a fair average. Of the twenty-seven samples examined, the tartrate of lime was determined in twelve of them which were not adulterated. The amount varied from a trace in one sample to 10.59 per cent. as a maximum. Nor did the article as sold for medicinal purposes appear in any way superior to that sold by grocers.

The following table gives the results of the twelve samples examined:

			Tartrate of lime.	
1.	Bought	of a grocer	3.54	per cent.
2.	"	"	10.47	"
3.	"	"	9.08	"
4.	"	"	6.25	"
5.	"	druggist	10.38	"
6.	"	"	10.03	"
7.	"	"	8.78	"
8.	"	"	5.50	"
9.	"	"	8.97	"
10.	"	"	6.62	"
11.	"	grocer	a trace	"
12.	"	"	10.59	"

Baking Powders.— These are artificial preparations employed as substitutes for yeast in the raising of bread, biscuits, etc. They consist of bicarbonate of soda and some acid or acid salt which, upon the addition of water, react on each other with the elimination of carbonic acid gas. The bicarbonate of soda is common to them all, but various acid compounds have been employed to liberate the gas, and from them the powder naturally takes its name.

There are four classes of baking powders in common use. In the first cream of tartar is employed, in the second tartaric acid, in the third acid phosphate of calcium, and in the fourth potash or ammonia alum. Moreover many powders contain a salt of ammonia. In the alum powders it occurs as a constituent of the alum itself, while in others it is, as a rule, introduced as the sesquicarbonate of ammonia. The pungent odor which this salt possesses prevents its use in any but the smallest quantities, and so used it cannot be considered as in any way affecting the wholesomeness of the powder. Experience has shown that when the acid compound and the bicarbonate are mixed, a reaction gradually takes place between them, which liberates the gas before it is needed, and results in a certain deterioration of the powder. To

counteract this, flour or starch is generally added to the mixture, which increases the keeping quality of the powder, although it cannot entirely prevent the deterioration. This "filling" as it is called, cannot be considered as objectionable if used only in such amounts as are necessary to preserve the powder, but it may be added in such quantities that it will be nothing more nor less than adulteration. To define adulteration in this connection would necessitate the fixing of some limit to the amount of flour or starch which might be added. There are certain difficulties which attend the fixing of such a limit. The various mixtures of bicarbonate of soda with acid salts do not furnish the same percentage of gas, inasmuch as some of these salts possess greater acidity than others. It follows that the manufacturer employing the salt of greatest neutralizing power might justly claim the right to use more filling, inasmuch as his powder would have greater strength, or liberate a larger percentage of gas. To avoid this difficulty it would be necessary to fix some standard amount of gas which the different powders should yield, and then the question of "filling" would regulate itself. Just what such a standard of available gas should be it would be difficult, and without considerable experiment, impossible to decide. The amount of filling which I have found ranges from 20 to 60 per cent., although it may be more than that in powders in which it was not determined.

Eighty-four baking powders have been submitted to me for examination, which on analysis I find to be divided as follows:

Cream of tartar powders	49
Tartaric acid powders	3
Alum powders	20
Phosphate powders	3
Cream of tartar and alum powders (mixed)	8
Phosphate and alum powders (mixed)	1
	84

Seventy-three contained either flour or starch, while eleven had no filling whatever. Thirty-five contained ammonia in some form of combination. Of the total number examined, eight powders were adulterated, six with terra alba, one with insoluble phosphate of calcium, and one with tartrate of lime, doubtless as an adulteration of the cream of tartar employed.

Flours, Bread, etc.

Flour.— The term flour, in its more restricted sense, is applied to the powder obtained by grinding the various cereals used as food.

The object of this paper being to ascertain the extent and nature of adulteration with the view of applying some correction for the evil, it is obviously foreign to such purpose to enter into any elaborate description of the nature of the different flours, or discussion as to analytical methods, except so far as it is necessary to reach the object in view.

Wheaten Flour.— It is somewhat unfortunate that any of the cereals and cereal preparations submitted for examination were "free" samples, since it would seem to indicate a certain amount of knowledge as

to the purpose in obtaining them, and consequently warrant the inference that they represent the best quality sold in the State, and not the poorest nor even an average quality. On the other hand I have no information to warrant the supposition that there is any considerable adulteration practiced.

Thirty-three samples of wheat products were submitted to me for examination, including eight samples of "gluten flour," and three samples of "farina," besides several samples of graham flour. There are quite a number of "gluten flours" on the market, which are supposed to contain a special addition of gluten. The samples which I have examined I find to be free from adulteration, and while some contain little or no more gluten than is normally present in wheaten flour, others are honestly deserving of the name — gluten flour. These conclusions I have reached by microscopical examination, the chemical analysis necessary to determine the relative value of these flours, I have not had the time as yet to complete.

The samples of "farina," which consist of finely granulated wheat, were found of excellent quality, as also the samples of wheaten flour and graham flour, the latter consisting of the unbolted flour of wheat.

The adulterations of wheaten flour may consist, first, of an admixture of foreign flour or meal, as that of barley, corn, bean, rice and potato, or secondly of mineral matter, as alum, clay, chalk, etc. The addition of corn meal to flour is reported as having occurred in this country, although I have not noticed cases of this kind; the addition of mineral matter is of rare occurrence. Damaged flour is sometimes placed upon the market, mixed either with good flour, or with some mineral matter, as alum, the action of which is to disguise its inferior quality. The use of alum, so far as it acts injuriously upon the human system, will be considered elsewhere, but its employment in damaged flour should be emphatically condemned, aside from the question of its wholesomeness. In damaged flour the gluten has undergone a partial decomposition or fermentation, giving a dark appearance to the flour. The alum acts as an antiseptic, checking this decomposition and giving a bread much whiter than could otherwise be obtained. For the same purpose it is sometimes added to sound flour to give an unnaturally white bread.

Another cause of deterioration in flour and one occasionally met with is the presence of some animal or vegetable parasite of the grain; and of these, smut, mildew, darnel, rust and ergot are the most important. The limits of this paper will not allow any discussion of these parasitic growths, nor of the more common animal parasites. There seems, however, to be sufficient ground for the statement that some of the ill effects generally attributed to other causes are in reality due to a vegetable parasite. From my own experience I am inclined to think that darnel will be found much more frequently than other vegetable parasites, and even this I have not noticed except in carelessly cultivated cereals.

Of the other cereal preparations which I have examined little need be said. They are as a rule free from adulteration, and the methods for detecting the adulterations of wheaten flour apply also in the case of other flours and cereals.

Oatmeal, Rye, Barley.— Twelve samples of oatmeal, ranging in price from five to fifteen cents per pound, seven samples of barley preparations and the same number of rye products were submitted for examina-

tion. They were found to be free from adulteration with the exception of one sample of rye flour, which had received an admixture of an inferior wheaten flour.

Corn Meal.—I have examined ten samples of corn meal, both yellow and white, and two of corn starch. The latter consist of the fine flour of corn and are of good quality, while the former contained nothing worse than meal worms, and these in but a few instances.

Rice.—Five samples of rice and rice flour were examined, and in no case were foreign substances found. The rice grain, as that of other cereals, is not liable to adulteration, although on a previous occasion I found considerable white sand present in one sample.

Buckwheat.—Eight samples of buckwheat flour were submitted, and in only one instance was there indication of adulteration. That consisted in the addition of wheaten flour.

Sago and Tapioca.—Sago is obtained from the pith of several varieties of palm, and in the form of meal or flour consists of a white powder. As sold in the shops, however, it generally consists of small grains, in the preparation of which heat is employed, and hence the shape of the starch granules is materially modified. Tapioca is obtained from the farinaceous root of various species of *Manihot.* It is found in commerce as granulated, pearl or flake tapioca, and the same starch when prepared without the aid of heat is often known as Brazilian arrowroot. Sago and tapioca are sometimes adulterated with potato starch, but this and other foreign matter are readily detected by the aid of the microscope.

Five samples of sago, and seven of tapioca were examined. The latter were free from adulteration, but in the case of the sago two samples consisted entirely of tapioca.

Arrowroot.—Genuine arrowroot is the starch obtained from the tubers of *Maranta arundinacea.* The term, however, is also applied to a number of other starches, notably those from *Canna edulis*, or Tous les mois arrowroot, *Tacca oceanica* or Tahiti arrowroot, *Arum maculatum* or Portland arrowroot, and *Curcuma angustifolia* or East Indian arrowroot. Corn, rice and potato starches are often called arrowroots, and there is therefore much confusion with regard to the use of this word. This confusion is rather increased by applying to the arrowroots some name supposed to indicate the place of their production, as Bermuda, St. Vincent, West India, etc.

The adulterations of maranta arrowroot are confined almost exclusively to the admixture or substitution of some cheaper starch. Taking the term arrowroot, in its more comprehensive sense, it includes substances composed solely of starch, and hence adulteration would be the substitution of a starch of less commercial rather than dietetic value. As a general thing the cheaper starches are sold at the same price as the genuine article, and therefore constitute a fraud upon the public.

It is evident that the remedy consists, in the first place, in requiring all dealers to mark the arrowroot with the name of the plant from which it is obtained. This is done in a few cases at present, but usually the geographical name is affixed. Mixtures of different starches should be marked as such. The microscope affords the only reliable means for detecting the adulteration of arrowroot with foreign starches.

I have examined twenty-three samples of commercial arrowroot, of which seventeen consisted entirely of maranta starch, and six of sub-

stitutions; one was a mixture of maranta and tapioca starches, two were maranta, tapioca and potato, and three consisted of tapioca and potato starches.

Bread.— Ten samples of wheaten bread were submitted to me, and in no case did the chemical or microscopical examination show adulteration. The samples in most cases represented the cheaper class of breads, the price of which is five or six cents for a loaf of from thirteen to fifteen ounces.

I determined in each sample, first, the moisture ; second, the ash ; third, the silica and sand ; fourth, the phosphates of alumina and iron. The last was necessary in order to ascertain whether the samples had been adulterated with alum. Tests were also made for the sulphate of copper, but in no instance was it detected.

The results of the analyses are given in the following table:

No.	Moisture. Percentage.	Ash from 100 grms. of bread. Grms.	Silica and sand from 100 grms. of bread. Grms.	Phosphates of alumina and iron from 100 grms. of bread. Grms.
1	41.60	0.997	.0028	.0039
2	43.60	1.134	.0078	.0073
3	43.34	1.006	0041	.0057
4	43.77	0.983	.0047	.0039
5	41.54	0.943	.0048	.0058
6	41.54	1.035	.0055	.0051
7	43.46	1.113	.0071	.0051
8	43.41	0.915	.0089	.0060
9	43.88	1.025	.0026	.0045
10	41.89	0.915	.0078	.0060
Aver.	42.80	1.0066	.0056	.0053

It should be stated that the examinations were made on the day the bread was baked, and only the crumb was taken for analysis.

It will be seen that more than half of the samples of bread examined contained over forty-three per cent of moisture. This quantity is certainly in excess of what should exist in well-made bread ; but at the same time, the figures may be taken as representing the amount of moisture in ordinary bakers' bread when fresh.

It is a matter of some difficulty to fix a limit to the amount of moisture allowable in bread. Mr. Wanklyn is of the opinion that well-made bread should not contain more than thirty-four per cent of water, while other writers fix a higher limit. In England, where bread is sold by weight, the unscrupulous baker may aim to overweight the bread with moisture and under such circumstances some limit would be very desirable, but as no such limit has been established in England, it would be difficult to settle upon a limit in this country where bread is generally sold by bulk.

In the above analyses the amount of ash is about the average of unadulterated breads. Moreover the silica and the phosphates of alumina and iron are only what would naturally occur in the ash of the flour.

Methods of Examination.

The microscope must be relied upon almost exclusively for the detection of the various starches, and abnormal vegetable growths. A few remarks on the identification of the starches will be found in the latter part of this paper.

The detection and estimation of mineral adulteration, are readily accomplished by ordinary analytical methods. The determination of alumina, however, for the purpose of deciding the presence of alum in flour and bread, requires considerable care, inasmuch as the amount of alumina even in alumed flour or bread is very small, and might be confused with that naturally present in the ash of the flour itself. It is customary to make a certain allowance for the alumina of the ash, but no fixed amount has been agreed upon by analysts. Various writers allow from three to ten milligrams of phosphate of alumina in one hundred grams of bread.

In preparing this paper the comparatively small number of analyses which have been made, having this particular point in view, do not warrant a suggestion as to the proper limit, and moreover the matter is one which can be easily settled when the alum question is disposed of.

After repeated trials of the various methods commonly employed in determining alumina, I am of the opinion that the one suggested by Mr. Dupré (*48), and modified by Mr. Wanklyn (155), is best suited to the determination of the alumina in flour and bread. It depends upon the insolubility of the phosphate of alumina, and the solubility of the phosphates of calcium and magnesium in acetic acid.

Mr. A. W. Blyth (14) has recently proposed a new method for the quantitative estimation of alum in bread, which is based upon the separation of the alum, and of any phosphate of alumina by their solubility in a five per cent solution of hydrochloric acid. The silicates of alumina are not acted upon by an acid of this strength, so that the alumina natural to the flour does not interfere with the determination of alum which may have been added.

The analyses of bread already given, were made before the publication of Mr. Blyth's paper, so that no opportunity was afforded for making a comparison between the method suggested, and that of Messrs. Dupré and Wanklyn.

While Mr. Blyth does not claim to have established the superiority of the hydrochloric acid method, it appears probable that it will afford a more reliable means of detecting the presence of alum in flour and bread.

A qualitative test for alum which has received considerable attention deserves mention here. It is based upon the fact that flour or bread containing alum is colored blue or lavender by a tincture of logwood. This test was applied to the samples of flour and bread examined, and in no case was the presence of alum shown. The test was applied according to the directions given by Mr. J. C. Bell (8). The tincture is prepared by digesting sixteen grams of freshly-cut logwood in cold methylated spirit for eight hours, and pouring off the clear liquid. "For bread, about ten grams of the crumb are taken, and a mixture consisting of 90 c.c. of water, 5 c. c. of the logwood solution, and 5 c. c. of a saturated solution of carbonate of ammonia is poured over the

*These numbers refer to the bibliography at the end of this paper.

bread in a porcelain dish. If the bread contains alum, a dark lavender-blue soon makes its appearance." The bread is washed and dried, when, if the color remains, it is taken as indication of the presence of alum. In applying the test to flour, ten grams are mixed with 10 c. c. of water, and to this are added 1 c. c. of the logwood solution, and 1 c. c. of the carbonate of ammonia solution. Pure flour gives a pinkish color, but if alum is present the color is a lavender-blue.

Of course in the use of such tests as this, confirmatory tests should be applied, and where prosecution is contemplated, quantitative determinations should be made.

Mr. Blyth, in the paper already referred to (14), suggests an improvement in applying the logwood test. It depends upon the known property which gelatine possesses of uniting with alum. A small piece of gelatine is digested with the suspected sample of flour or bread until quite soft, after which the logwood test is applied.

THE ALUM QUESTION.

In the making of bread, and foods of a similar nature, alum is sometimes added to the flour for one of two reasons, either to disguise the inferior quality of a damaged flour, or in combination with other substances as a substitute for yeast, in the form of a baking powder.

Aside from the question of the wholesomeness of alum, its use in remedying the defects of damaged flour cannot be looked upon as other than a very objectionable form of adulteration, which should be emphatically condemned. The action of alum on flour is to toughen the gluten, and retard those changes in the process of fermentation produced by the use of yeast, and which if allowed to go too far, would render the bread heavy and sour. In the use of damaged flour this effect of alum is of the greatest importance and enables the unscrupulous to make a bread possessing the appearance of a first-class article, from material unfit for human food.

The almost universal use of baking powders in this country, and the fact that a large number of them contain some form of alum renders the question of their wholesomeness one of interest and importance. The question as it has been discussed in England and France has referred more to the use of alum in breads when employed to improve the appearance only, and in this case certainly it is of the nature of an adulteration. In this country, on the other hand, the question which commands more immediate attention is the use of alum in baking powders where it plays a part which must be performed by this or a similar substance if the powder is to accomplish its object.

Much has been written and many varying opinions expressed as to the action of alum on the human system. Most or all of these opinions seem to be based upon theoretical grounds, and I do not find that any systematic experiments have been made to settle the question. I am not speaking of the use of alum medicinally, but as it might be taken in articles of food in combination with other substances; and in the following pages I shall endeavor to bring to the surface the opinions on both sides.

Some persons have argued the question apparently upon the physiological effect of alum as given in works on Materia Medica, concluding that its effects, as usually taken in food, are necessarily the same.

According to Dr. Pereira (121, p. 230) "the immediate *topical* effect of a solution of alum is that of an astringent; namely, corrugation of fibres and contraction of small vessels, by virtue of which it checks or temporarily stops exhalation and secretion, and produces paleness of parts by diminishing the diameters of the small blood vessels. It is by these local effects that alum, when taken internally, causes dryness of the mouth and throat, somewhat increases thirst, checks the secretions of the alimentary canal, and thereby diminishes the frequency and increases the consistency of the stools. But when alum is applied to a part in larger quantities, and for a longer period, the astriction is soon followed by irritation, and the paleness by preternatural redness. And thus taken internally in large doses, alum excites nausea, vomiting, griping, purging, and even an inflammatory condition of the intestinal canal — effects which may be perhaps induced by small quantities in persons endowed with unusual or morbid sensibilities of the stomach and bowels." He also adds that "alum becomes absorbed," and states that Orfila detected alumina in the liver, spleen and urine of animals to whom alum had been administered. Other opinions on this point are not necessary, as those who advocate the use of alum would hardly deny the truth of Dr. Pereira's statement; but it is urged that the alum is decomposed in the baking process and consequently does not enter the system in the form of alum, but as the hydrate or phosphate of alumina. Moreover that the quantity is small, and like many other substances produces injurious effects only when taken in larger quantities.

Prof. Liebig (86, p. 541) says that when alum is added to bread it is decomposed, the phosphoric acid of the flour uniting with the alumina to form a phosphate of alumina, difficultly soluble in acids and alkalies.

Dr. Hassall (67, p. 349) says on this point that "when alum is added to flour or bread, it becomes decomposed, sulphate of potash, an aperient salt, being formed." Mr. Blyth (13, p. 33) says that "when water is put to dough, the alum (unless, indeed, it has been added in excessive quantities) is broken up and ceases to exist as alum." Dr. Parkes (113, p. 246) says "when mixed with flour and baked, the alum is decomposed, part of the alumina combines most strongly with phosphoric acid; and either this or the alum itself is presumed to be in combination with the gluten; bisulphate of potassium is probably formed." He adds on the following page "there is little doubt of the formation, and none of the insolubility of phosphate of alumina." From this it seems probable that alum as such does not enter the system, but is decomposed previous to and during the process of baking.

In the use of alum baking powders, the addition of water effects the reaction between the alum and the bicarbonate of soda, forming the hydrate of alumina, together with sulphate of soda and sulphate of potash or ammonia according to the nature of the alum.

Prof. Liebig thinks the phosphate of alumina is ultimately formed and that it is insoluble, in which case it would be unacted upon by the digestive fluids. Mr. J. W. Knights in the Norfolk Baking Powder Case (107 p. 231) testified that alum was converted into a phosphate, with a small quantity of the hydrate of alumina, that this phosphate was insoluble and destroyed "all the beneficial effects of bread made from flour." Further on he says "alum is a strong astringent," etc. If the alum is converted into an insoluble compound, why discuss its astringent properties; and again, is there nothing beneficial in bread but the

phosphoric acid? Prof. Muir (107, p. 232) is of the opinion that the baking powder acts upon the greater part of the soluble phosphate of the flour and forms an insoluble phosphate of alumina.

Dr. Tidy (107 a, p. 31) doubts whether the phosphate of alumina is formed at all, and even if it is formed, he is confident that it would be dissolved in the gastric juices. Mr. Sutton (107, p. 233) denies that alum baking powder in bread tends to harden the gluten and make it indigestible. "The phosphate would be perfectly inert and harmless to health." He also made some experiments with bread raised with powder and also with yeast, and determined the phosphoric acid present. The yeast bread gave 3.04 grains of phosphoric acid as phosphates soluble in cold water, while the bread made with baking powder gave 2.32 grains, showing that comparatively little of the phosphoric acid was rendered insoluble by the hydrate of alumina. Dr. Thudicum (107 a, p. 31) thinks that the phosphate of alumina, if formed, would be entirely decomposed by the gastric juice of the stomach; and with regard to the loss of phosphoric acid in the human body by the use of an alum powder, he adds, "that it would be quite inappreciable and of no consequence whatever." Prof. S. W. Johnson (101, p. 118) does not recognize the conversion of the hydrate of alumina into the phosphate, and he considers that the hydrate would be dissolved by the acid fluids of the stomach and so have the same effect as any other soluble salt of alumina. There appears therefore to be considerable doubt as to whether the phosphate of alumina is formed or not. If the phosphate is formed there is reason to suppose that it is decomposed by the fluids of the stomach, although this is by no means an established fact, and just how far the new compound resembles an alum in its properties there is some uncertainty. There is no ground for concluding, however, that its action is the same as that of the original alum.

The literature on the subject of alum in bread making, has of late years become so voluminous that it would be impossible within the scope of this report to give more than a few representative opinions.

Liebig's objection to the use of alum was that it rendered the phosphoric acid of the flour insoluble, and also that it permitted the use of damaged flour.

Dr. Pereira (120, p. 311) says: "Whatever doubts may be entertained regarding the ill effects of alum on the healthy stomach, none can exist as to its injurious influence in case of dyspepsia."

If alum or the hydrate or phosphate of alumina into which it may be converted in the process of baking has any injurious effect, the effect would be most and soonest felt by one whose digestive functions were impaired. While Dr. Pereira is quite positive as to its injurious effect, his conclusion seems to be based on theory rather than on actual experiment.

Dr. Desnos (41) writes: alum, or calcined alum, passing into the stomach in a state of hydrated alum, its toxical qualities are *very problematic.*

It is stated on the authority of Dr. Prosper de Pietra Santa that the Society of Physicians of London have condemned this adulteration with unanimity.

Prof. Alp. Chevallier (22, p. 20) regards the use of alum as injurious, and says that it should never enter into any alimentary preparation.

A. Trébuchet (149, p. 86) says: although it appears to have been

proven that alum may be administered medically in very large doses (8 to 24 grams) without any appreciable injurious results, and in spite of the very apparent harmlessness of the admixture of a small piece of alum to the bread, the Council of Health of Paris has seen fit that it should be forbidden to any baker to employ this salt (alum) in the making of his dough.

Dr. Dauglish (67, p. 344) says: "But its action in neutralizing the efficacy of the digestive solvents is by far the most important and unquestionable. The very purpose for which it is used by the baker is the prevention of those early stages of solution which spoil the color and lightness of the bread whilst it is being prepared, and which it does most effectually; but it does more than needed, for whilst it prevents solution at a time that is not desirable, it also continues its effect when taken into the stomach, and the consequence is that a large portion of the gluten and other valuable constituents of the flour are never properly dissolved, but pass through the alimentary canal without affording any nourishment whatever."

Dr. Pavy (116, p. 238) in speaking on this subject says: "In the first place, alum, or whatever it may be changed into, or whatever the combination formed with the flour under the agency of the heat employed in baking, is not a natural article for ingestion. Its properties are not such as to be likely to occasion any immediate or strong effect, and it cannot be said that a deleterious action is to be brought home to it in a precise or definite manner, but it is believed to be capable of producing dyspepsia and constipation."

Dr. Hassall (67, p. 349) says: "The use of alum in bread is particularly injurious, * * * it hardens the nutritious constituent of the bread, the gluten, * * it enables the baker to adulterate his bread with greater quantities of rice and potatoes, * * and lastly by the use of alum he is able to pass off an inferior and even a damaged flour, for one of superior quality. * * * Further, alum is very apt to disorder the stomach, and to occasion acidity and dyspepsia. * * * The manner in which it does so has not been clearly ascertained."

Dr. Parkes (113, p. 248) says: "A question like this is obviously difficult of that strict proof we now demand in medicine, and personally I have been able to come to no conclusion. Seeing, indeed that the usual effect of bad flour is flatulence and diarrhœa. if constipation were decidedly producd by bread, it would be more likely to proceed from alum than from any other ingredient of the bread." He considers that in view of the large quantity of alum often added to bread, if aluminium phosphate acts as an astringent, a person might take in an ordinary meal an amount sufficient to produce constipation. "Looking then to the positive evidence, and the reasonableness of that evidence, it seems to me extremely likely that strongly alumed bread does produce the injurious effects ascribed to it."

Mr. Blyth says (13, p. 33): "The influence of alum, on health, in the small quantities in which it is added to bread, is very problematical and rests upon theory more than observation. * * * But notwithstanding the obscurity as to its action on the economy, there can be no difference of opinion that it is a serious adulteration, and not to be permitted." As to the use of alum in baking powder it is employed as a substitute for some other acid salt as cream of tartar, or acid phosphate of lime, which have been considered harmless, and if the effect of alum

on the health is problematical as Mr. Blyth claims, there seems to be no sufficient reason for prohibiting its use.

Mr. Church, A. H. (33, p. 69) says: "Alum and sulphate of copper are dangerous adulterants when added to a material in daily use like bread."

Dr. Thudicum in the Norfolk Case (107 a, p. 31) testified that he did not consider the use of the powder (alum) injurious. Dr. Tidy (107a, p. 13) testified in the same case that he did not think the powder injurious. Dr. Letheby, discussing a paper on Bread Manufacture (39, p. 260) said that the alum question was still a moot question; and Dr. Odling in the same discussion said he did not think the use of alum in small quantities prejudicial.

Some experiments have been made by Mr. J. West Knights (80, p. 18) to ascertain "the effects of the antiseptic power of alum in impairing the action of the solvent juices of the body." He prepared an artificial gastric juice by dissolving pepsin in very dilute hydrochloric acid, and subjected to the action of this fluid gluten obtained from pure wheat flour. Two grammes of the gluten were boiled ten minutes in pure water, then removed and on digesting in the gastric fluid at a temperature of from 90 deg. to 96 deg. F. was dissolved after five hours. Another portion of two grammes was first boiled in water containing a small quantity of alum, and then digested in the gastric fluid for five hours, when the undissolved portion was found to equal 1.05 grammes.

A third experiment was made in which the gluten was boiled in water containing small quantities of alum and bicarbonate of soda, and after treatment with the gastric fluid there remained .90 gramme of undissolved gluten, of two grammes taken. In the fourth experiment two grammes of gluten were first boiled in water containing alum and phosphate of soda. After being digested with the gastric fluid as in the previous experiments, .80 gramme of the gluten was left undissolved. "The results of these experiments prove that alum either alone or with bicarbonate of soda, or in the presence of soluble phosphates exerts a powerful action on the digestibility of gluten in the stomach."

Other experiments were made with two samples of bread, one of which was raised with yeast and the other with alum baking powder. A portion equal to 1.2 grammes of dry bread was taken from each, and after treatment with the gastric juice, the residue left from the yeast bread weighed .4 gramme, while that from the alum bread weighed .66 gramme, "thus showing that the pure bread was about one-third more soluble in the gastric juice than the bread that contained the alum baking powder."

Mr. Knights also calls attention to the injurious action of alum in hindering the solvent action of the saliva upon the starchy matter of the bread. For the purpose of showing this action experimentally, malt was employed, the diastase of which was considered to have an action similar to that of the animal diastase of the saliva.

"Two separate portions of malt were weighed, of one gramme each; to one portion one-tenth of a gramme of crystallized alum was added; both portions were then digested with equal quantities of hot water at a temperature of 160 deg. F. (a temperature very favorable for the conversion of starch by diastase), and maintained at that temperature half an hour; at the end of which time both samples were filtered; the filtered liquids were evaporated to dryness, and the residues which represented that

portion of the malt that had been dissolved by the mashing process, were weighed: the sample without alum had produced seventy per cent of soluble matter; the sample that had been treated exactly similar, with the exception that a small quantity of alum had been added, produced only eight and a half per cent. of soluble matter obtained from the malt."

It should be remarked that the amount of alum added in this experiment is four or five times greater than that employed in practice, and of course no such disastrous result would be produced as that given by Mr. Knights. In regard to all these experiments the question naturally arises, how far the experimenter has succeeded in imitating nature in the preparation of the artificial gastric juice, and also to what extent the subsequent experiments can be taken as representing the natural process of digestion.

In the first experiments no mention is made of the amount of alum employed, and judging from the last experiment it is possible that in every case, the amount was in excess of that used in the practical operation of bread making.

At best the methods of nature are very difficult to imitate and in conducting experiments to decide points of this kind natural conditions should be reproduced as far as possible. Some substances, considered as injurious, act very slowly and an exaggerated experiment is necessary to prove the nature of that action. At the same time when there are so many unknown quantities as exist in experiments upon the animal organism, long series of experiments under all the varying natural conditions of the subject are necessary in order to reach satisfactory conclusions.

There are on record a few cases of persons being taken sick after eating bread found to contain alum, but it has not been shown that the alum was the cause. Attention has already been called to the fact that alum is sometimes added to damaged flour to stop and partially correct the injurious effect of the fermentation, and it is not impossible that some of the effects ascribed to alum may be, as Dr. Parkes suggests, really owing to the flour. As the "usual effect of bad flour is flatulence and diarrhœa, if constipation were decidedly produced by bread it would be more likely to proceed from alum than from any other ingredient of the bread."

In 1840 Dr. Lefébure stated that several families of his clientage were suffering with gastro-intestinal ailments which he recognized were produced by bread containing alum. At least alum was found in the bread and it appears that he inferred that alum was the cause of the trouble.

I have used in my own family an alum baking powder for six weeks continuously. It was employed in making biscuit, and the amount of powder taken daily by each individual was equivalent to from seventeen to thirty-four grains of desiccated ammonia alum. It was impossible to detect any inconvenience whatever in the use of the alum powder, but it should be added that there are no dyspeptics in my family so that no opportunity was afforded for ascertaining the action of the powder under circumstances where any injurious effect would be most noticeable.

Legislation.— In England in 1821, during the reign of George IV, an act was passed which prohibited the use in the making of bread for sale, of alum or of any preparation or mixture in which alum was an ingre-

dient. The penalty for violation of the law was a fine from £5 to £25. By the Statute Law Revision Act of 1861, this was repealed, and the act as now in force in England does not forbid the use of alum, although public sentiment is generally opposed to it. It follows that under the English Sale of Food and Drugs Act, there can be no conviction for the use of alum unless the prosecution can establish the fact that alum is injurious to health.

In France the use of alum in bread-making is not allowed, although there is no law specially prohibiting it. This is fully explained in the following extract from an article on the subject of "alum in bread-making" recently prepared for the Sanitary Engineer by Dr. Prosper de Pietra Santa of Paris.

Art. I of the law of 1851, prohibits under penalties (fine and imprisonment) the adulteration of substances, either alimentary or medical, intended for sale; and since adulteration is defined to be the voluntary addition to any substance whatever of a product foreign to it, for the purpose of fraud or gain; and again since the regulations of the Prefecture of the Police do not admit in the making of bread of any other substance than flour, water, salt and raisings, it results that in France alum cannot be employed in the manufacture of bread.

In Germany both sulphate of copper and alum are forbidden in bread making. (42, p. 126.)

In conclusion it may be said that at the present time there does not seem sufficient evidence as to the injurious effects of alum upon the human system to warrant legislation against it. That alum as used ordinarily in bread making is unattended by any immediately injurious results seems reasonably certain, but further and more exhaustive experiments are necessary before the question can be satisfactorily settled regarding its action upon the human system, especially in cases of weak digestive organs. Experiments should be made upon subjects in ordinary health. To prohibit the use of alum on the ground that it is injurious to dyspeptics would be to subject it to a very severe test — a test which many articles of food of daily consumption could not stand successfully. Such a standard could be adopted only upon the ground that bread and like preparations were too important as articles of diet to have their value in any way impaired. Less objection is, at present, made to the use of alum than was the case several years ago, and still further experiment might show that even this objection was without foundation.

On the Identification of the more commonly occurring Starches.

The microscope forms a very important, and in many cases the only means, of detecting food adulterations, and nowhere is its usefulness more apparent than in the examination of the various starches.

It is an interesting fact that while the starches obtained from cereals, bulbs, seeds, etc., are identical in chemical composition, and, as a rule, present to chemical reagents no distinctive properties, each one has been given a form of its own with characteristics not shared with any other member of the group. For this reason the recognition of the different starches does not present any great difficulty, a careful study of the shape, size and peculiarities of each being all that is required.

The efforts which have been made to establish some microscopical

classification of starches, based upon the natural orders, have met with little success. Starches of different botanical orders often resemble each other more closely than those of the same order. The classification which more nearly meets the requirements is based entirely upon the microscopical appearance of the granules as regards the hilum, rings, etc. At the same time these classifications are of comparatively little service in the recognition of the starches. The characteristics upon which the classification is based will often be found to differ somewhat in different samples of the same starch; and sometimes the peculiar characteristics are entirely wanting. Moreover much depends upon the method of preparation and examination of the starch, and something must be allowed for the peculiarities of the observer. Where one would see lines or rings, another under the same conditions would not; and with variable factors existing in the light and magnifying power employed the difficulty becomes more evident.

Of the classifications proposed, the simplest is that of Dr. Parkes (113, p. 255). It includes, however, only the more common starches. A more complete classification is that of Dr. Muter (103, p. 172; and 103 a, p. 473); while a third is given by Dr. A. Vogl (152, p. 51).

The simplest and most satisfactory plan in the examination of starches is to have small specimens of the starches for comparison. They are conveniently kept in large-mouthed vials; and should be dry. Of course their origin and purity should be insured or they are quite useless. Mounted starches are not satisfactory for comparison.

In examining starches I have found that a mixture of water and glycerine (2:1) answers very well, although water, glycerine, Canada balsam, etc., are sometimes employed. As the mounting medium has more or less influence in bringing out the characteristics of the starch granules, it is important to employ the same medium both in the standard and in the specimen to be examined. A minute quantity of the starch is placed upon the glass slide, thoroughly moistened with a drop of the liquid and a glass cover put on. This should be pressed down very gently as excessive pressure or a grinding motion is liable to injure the starch granules. I prefer a one-fifth inch objective with B eye-piece, although a lower power is often recommended.

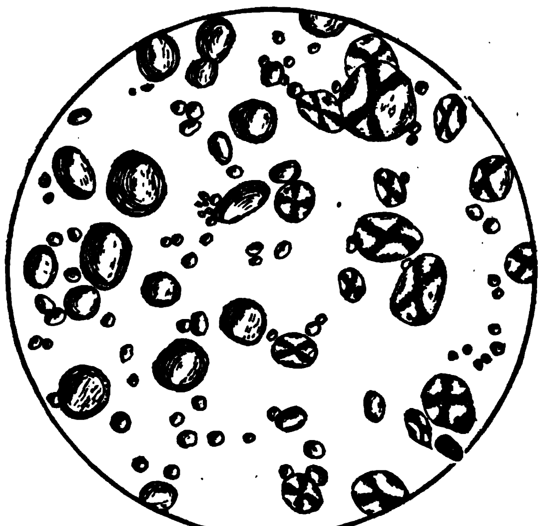
Polarized light is a very important aid in the identification of starches. By its use the rings are often more easily seen, and the position of the hilum is immediately ascertained, since the arms of the cross unite in the hilum. Some writers state that certain starches do not show the cross, and the statement has even been made with regard to wheat starch. This however is an error. The cross is readily seen in wheat starch, but with difficulty in the smaller starch granules, as those of rice and oat. I have noticed the cross in all the more common starches that are likely to come under the observation of the analyst.

The accompanying illustrations of the more common starches were drawn with the camera lucida, and reproduced from the drawings for the purpose of this report. The drawings of the sago and potato starches were made from microscopic slides which had been prepared for some time; in all other cases the drawings were made from fresh specimens. The illustrations represent on the right of the figure the appearance of the granules by polarized light, while on the left they are as ordinarily seen without this adjunct.

Wheat. The general form of wheat granules is circular, although

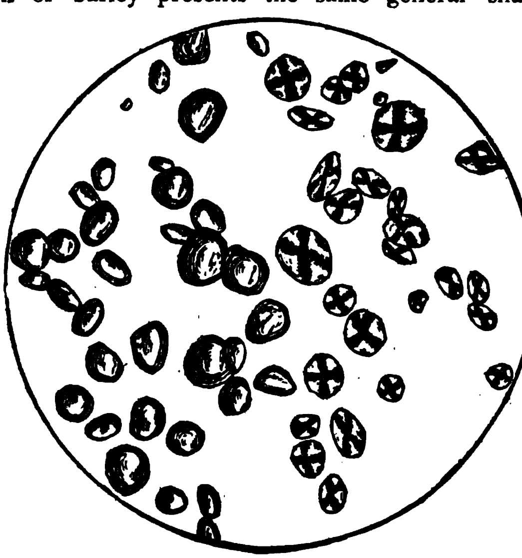
a few are elliptical, often irregularly so. As a rule the rings are invisible, but in the elliptical granules faint rings are sometimes seen. The hilum is occasionally seen as a central spot or short irregular fissure, but generally it is invisible. On looking at this starch the immediate impression is that two sizes of granules predominate — those of large size and others of very small size, with few intermediate.

The larger granules measure from .00111 to .00197 of an inch, while the small ones seldom exceed .00034 and often are only .00009 of an inch in length. With polarized light a cross is visible. In the circular granules this is dull and indistinct, but it is much clearer in those of elliptical form. With a green or red selenite plate, preferably the former, the circular granules show little change of color. In a few it is more decided, especially in the elliptical granules.



Wheat Starch. Drawn with the Camera Lucida, and magnified 250 diameters.

Barley.—The starch of barley presents the same general shape as the wheat granules, a few being elliptical but the greater number circular. In many granules the shape is slightly angular as though a piece had been cut off. In the majority of granules the rings are invisible, but in a few, faint ones are seen. The hilum is central, but is practically invisible. In looking at a slide of barley starch one misses the large number of very small granules so characteristic of wheat starch. The granules are of different sizes, a few are very small, being about .00018 of

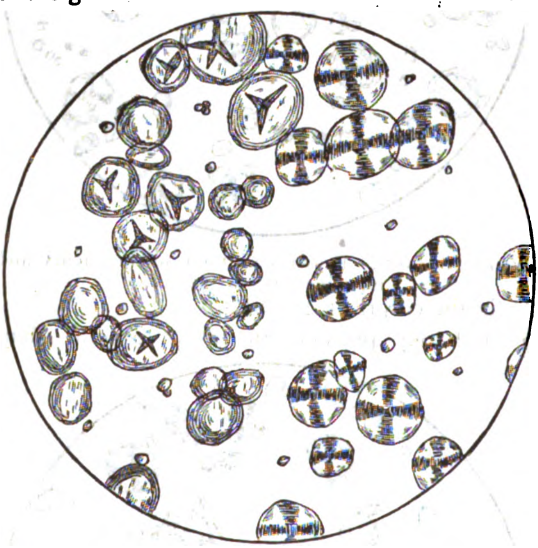


Barley Starch. Drawn with the Camera Lucida, and magnified 250 diameters.

an inch in diameter, but the majority range from .0005 to .0015 of an inch. The largest granules of barley starch are smaller than the largest of wheat starch. The identification of barley starch in the presence of wheat starch is quite impossible, but separately they may be identified, the sizes of the granules however being the only ground for such identification.

With polarized light barley starch presents much the same appearance as wheat. The elliptical granules are brighter and show a more distinct cross, while in the circular granules it is very dull. With a selenite plate this starch appears the same as wheat.

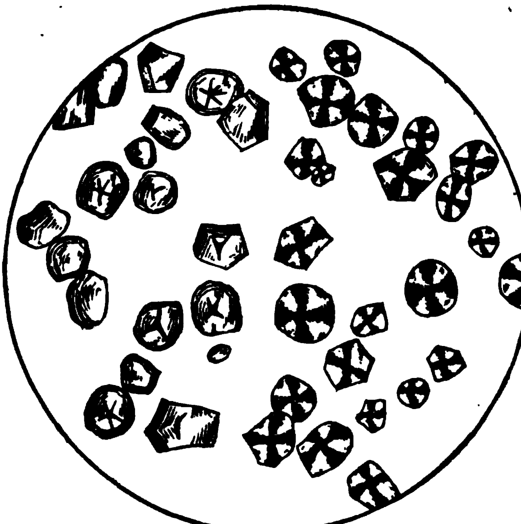
Rye.—In form the granules of rye starch are as like those of wheat and barley as it is possible to describe them. The rings and hilum are also quite invisible in the majority of granules. In examining rye starch most microscopic fields present one or more granules which are marked by a deep fissure extending from the centre in the form of a three- or four-armed star nearly or quite to the circumference of the granule. I have not found these fissures so frequently nor of so large size in the granules of wheat or barley; but their absence must not be considered as proving the absence of rye starch, as the fissured granules are of variable occurrence, and appear in some specimens more than in others, possibly depending upon the age and moisture of the sample. In size the largest of the rye granules are larger than those of wheat, and considerably larger than the largest of barley. There are also many very small granules, although not so numerous as in wheat starch. The small granules average about .00025 of an inch in diameter, while the larger ones vary from .0005 to .0018 of an inch. Rye starch, with polarized light, presents the same dull cross as wheat and barley starch, with an occasional brighter one. With a selenite plate it is like the preceding starches.



RYE STARCH. Drawn with the Camera Lucida and magnified 250 diameters.

Corn.—Corn starch granules are as a rule polygonal in form, the angles being sharply defined in some and considerably rounded in other granules. A few granules are round. The rings are either invisible or seen with difficulty in a few of the larger granules. The hilum however is well marked and consists of a small central spot, or as seen

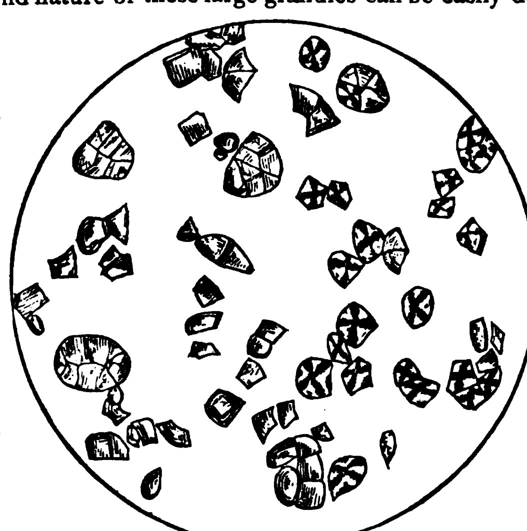
in the larger granules, of a straight or star-shaped fissure. The granules vary in size from .0003 to .0008 of an inch, and but seldom will granules be found to exceed these limits.



CORN STARCH. Drawn with the Camera Lucida, and magnified 500 diameters.

With polarized light corn starch granules present a distinct cross, the remainder of the granules being much brighter than with the average granule of wheat, barley and rye. The arms of the cross intersect in the centre of the granule. The colors as shown by a selenite plate are more brilliant than with wheat, but the effect is partly lost by the small size of the granules. The colors are more decided with the green plate.

Oat.—The starch granules of oat are generally polygonal in form, a few, however, are oval and others shaped like apple seeds. A peculiarity of this starch is the grouping together of these single granules into compound granules of considerable size. With sufficient magnifying power the compound nature of these large granules can be easily detected, but with low powers they might easily be, and indeed have been mistaken for single granules of large size. The form of the compound granules is generally oval, but occasionally they will be seen partly broken up into small granules. The rings and hilum are invisible unless the power employed exceeds one-fifth inch.



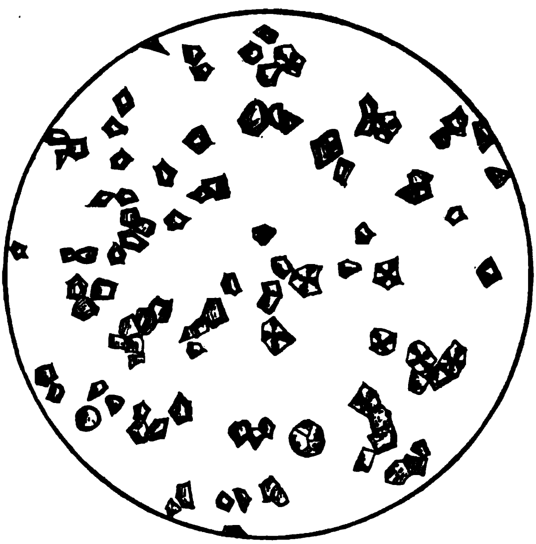
OAT STARCH. Drawn with the Camera Lucida, and magnified 500 diameters.

The granules vary in size from .00013 to .00045 of an inch, the average length being about .00035 of an inch.

The statement has

been made by some writers on this subject that the oat granules do not show the cross by polarized light. This, however, is an error. The cross can be seen with a one-fifth inch power, although it might be easily overlooked on account of the small size of the granules. The cross is not seen on first looking at the granules, but by slowly turning the analyzer, and looking at one particular granule the cross can be seen. In the largest granules it is, of course, seen most readily. It is also visible in the individual granules forming the compound granules. In no case, however, is it as distinct as might be inferred from the accompanying illustration.

Rice. Rice granules are, almost without exception, polygonal in form, generally with sharply defined angles somewhat resembling oat starch. The granules are often found in groups, as with oat starch, but with rice the outline of these masses is very irregular. The rings and hilum are not visible with a power of one-fifth inch and under; but Dr. Muter states that with a one-eighth or one-twelfth inch power the hilum becomes visible. The granules vary in size from .0002 to .0004 of an inch. With polarized light the granules of rice starch show a cross the same as oat starch, and although very faint and only visible in the largest granules it can be seen with a one-fifth inch power. In the accompanying drawing the cross is shown in but a few of the larger granules. The selenite plate does not aid in the study of these small granules under polarized light.

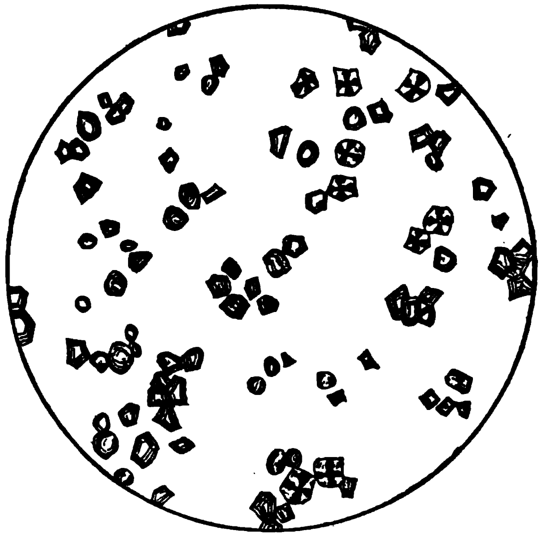


RICE STARCH. Drawn with the Camera Lucida, and magnified 500 diameters.

Buckwheat. This starch somewhat resembles those of rice and oat in the shape of its granules, the prevailing form being angular. At the same time the angles are more rounded, and in a few granules the form is quite round. The granules are often aggregated into small masses as with rice and oat starches. No rings are visible; but with a one-fifth inch power the hilum may be seen in many granules as a central spot or a minute star-shaped fissure, much more distinct than in either of the two preceding starches.

This starch has received less study than most of those usually met with, and consequently there are fewer recorded measurements of the granules. Vogl gives the size as from .00052 to .00086 of an inch, and Hager as from .00059 to .00096 of an inch. A number of measure-

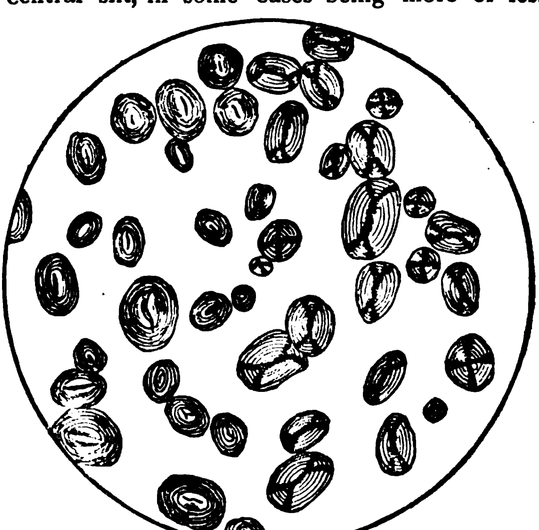
ments recently made of freshly prepared specimens gave from .0002 to .00053 of an inch as the size of the buckwheat granules. It seems probable that the measurements given by Vogl and Hager have reference to a species of buckwheat possessing naturally granules of larger size. With polarized light buckwheat starch presents a clearly defined cross which can be seen without difficulty. There is no very decided change of color by the use of the selenite plate.



BUCKWHEAT STARCH. Drawn with the Camera Lucida, and magnified 500 diameters.

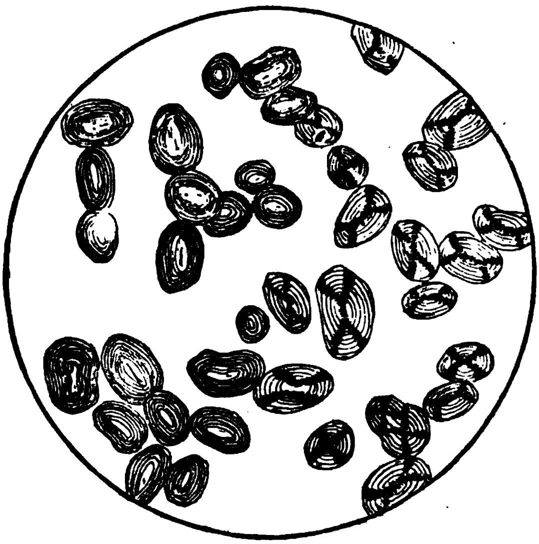
Bean. The granules of bean starch are generally of an oval shape, occasionally reniform or kidney-shaped. When magnified 250 diameters the concentric rings are visible, although somewhat faint. The hilum is very distinct as a central slit, in some cases being more or less branching.

The granules vary in size from .0008 to .0018 of an inch, with occasional ones as small as .0005 of an inch Under polarized light they present a very distinct cross, the remaining part of the granule being especially bright. In some granules the arms of the cross intersect at right angles, this being especially noticeable in those more circular in form; as a rule, however, the arms cross at an acute angle, producing a long, dark line of intersection through the centre of the granule. With a selenite plate, especially the green, the colors are unusually brilliant, although inferior to potato starch in this respect.



BEAN STARCH. Drawn with the Camera Lucida, and magnified 250 diameters.

Pea. In form the granules of pea starch are the same as those of bean, being oval and reniform. Some granules are very much enlarged at one end, and from the outline would be considered as a single granule. By the aid of polarized light, however, it appears that they are double granules, having two hilums and showing two crosses. A few triple granules are also seen. In a specimen of pea starch prepared from dried peas, and from which the accompanying illustration was drawn, the concentric rings were distinctly visible; but the hilum, on the other hand, was by no means as distinct as in bean starch. When it is visible, however, it resembles that of the bean granules. Writers on this subject have stated that the concentric rings are nearly invisible, and the hilum even more distinct than in bean flour, and by some these are given as distinguishing marks between these two leguminous starches. It is evident, however, that little reliance can be placed upon such distinctive marks which are liable to vary with the specimen examined. It is a difficult matter to distinguish bean starch from that of pea, and quite impossible to identify one in the presence of the other. The granules of pea starch range from .0008 to .0020 of an inch in length. Under polarized light pea starch presents the same appearance as bean starch, with the production of a well-defined cross, and giving the same bright colors with a selenite plate. As a rule the reniform granules of pea and bean starches give a double cross. So far as I am aware no other starches show this with the same frequency.



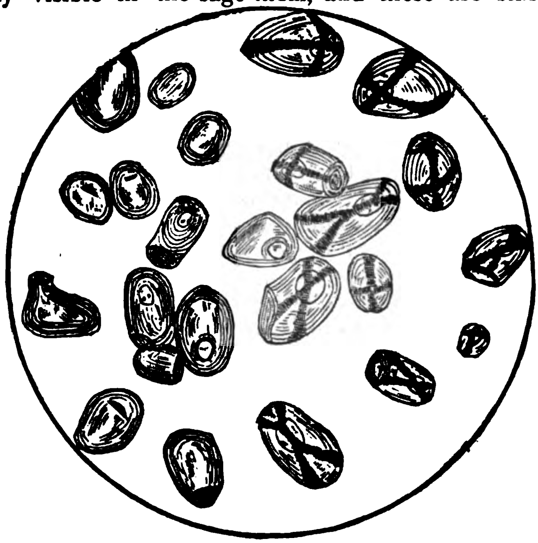
PEA STARCH. Drawn with the Camera Lucida, and magnified 250 diameters.

Sago.— Both sago and tapioca as found in commerce consist of the meal which has been dried on hot plates. The effect of this heating is to cause the granules to swell and sometimes to burst, in which case they lose many of their characteristics. A few unaltered granules will be found in every case, so that the starch is readily distinguished, although more careful study is needed to determine adulteration with foreign starches. The figure represents prepared sago, the granules having undergone little change by heating.

The granules of sago meal are for the most part oval in shape. Many of them are abruptly terminated at the end opposite the hilum as though broken off, and they present a more or less plane surface. In prepared sago the shape is much the same, but many granules are ruptured, the proportion of these depending upon the degree of the heat to which the starch has been subjected.

The rings are faintly visible in the sago meal, and these are still seen in a few granules of prepared sago. The hilum consists of a circular spot or frequently of a short slit or stellate depression, generally at the smaller end of the granule, but sometimes at the larger end. In prepared sago the hilum becomes a large oval depression, with occasionally the stellate hilum seen in the raw sago.

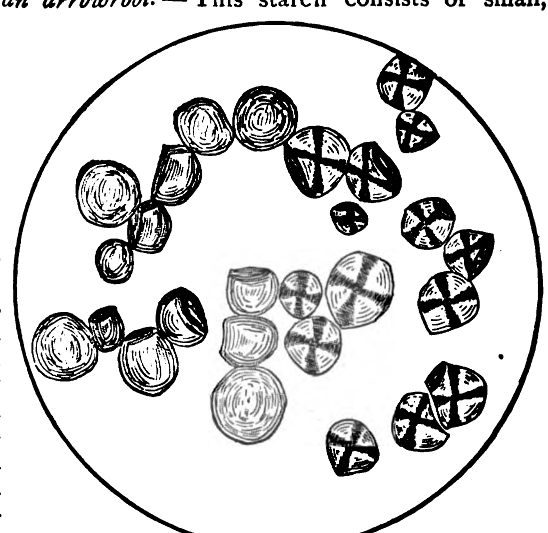
There is no difference in size between the granules of raw and prepared sago. They vary in length from .0012 to .0026 of an inch.



SAGO STARCH. Drawn with the Camera Lucida, and magnified 250 diameters.

With polarized light sago starch presents a well-defined cross closely resembling that of potato starch. The intersection of the arms of the cross is at the rounded and generally the smaller end of the granule. In prepared sago the cross is less distinct though visible; and if the granule is much ruptured the cross is very much distorted or even invisible. With a selenite plate the colors are very bright even in prepared sago.

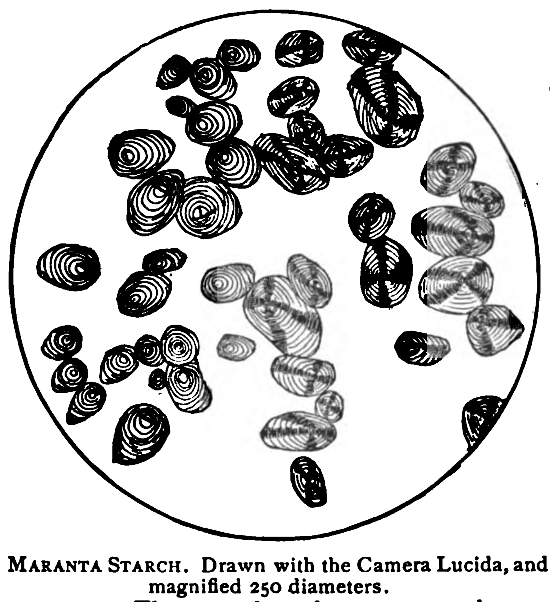
Tapioca, or Brazilian arrowroot.—This starch consists of small, roundish granules, for the most part circular at one end and plane at the other. A few appear perfectly circular. With a magnifying power of one-fifth inch no rings are visible. It is stated by some writers that rings are visible, and in such cases the starch was probably examined with higher powers. The hilum is readily distinguished as a small dot, or in a few granules as a short slit. In either case the hilum is central. The granules vary in size from .00044 to .00085 of an inch.



TAPIOCA STARCH. Drawn with the Camera Lucida, and magnified 500 diameters.

As already stated the prepared tapioca of commerce will be found to have had many of its granules altered by heating. A few retain their original form, but most of the granules are enlarged and often distorted. Under polarized light the granules of tapioca meal present a distinct cross, with the intersection of the arms in the centre of the granule. In the prepared article the altered granules still show the cross, although it is much duller than in the meal, and often it is indistinguishable. With a selenite plate the colors appear with much distinctness.

Maranta or Bermuda arrowroot—The granules of maranta arrowroot slightly resemble those of potato in their general form. The majority are oval or pear-shaped, some irregularly so, and a few are elliptical and mussel-shaped. The rings are visible with a one-fifth inch power, although somewhat fainter than in potato starch. The hilum is visible in most granules, and consists usually of a short slit at the broader end of the granule, occasionally in the centre of the granule and very rarely at the smaller end. The slit generally runs across the granule but sometimes lengthwise. Its position at the broader end constitutes a prominent distinction between this and potato starch, in which the hilum is at the narrower end of the granule. The granules of maranta starch are moderately uniform in size. The smallest are about .0006 of an inch in length, but the usual size is from .0008 to .0020 of an inch. With polarized light this starch presents a well defined cross similar to that of potato starch except that the centre of the cross is at the larger end of the granule. With a selenite plate the display of colors is very beautiful.

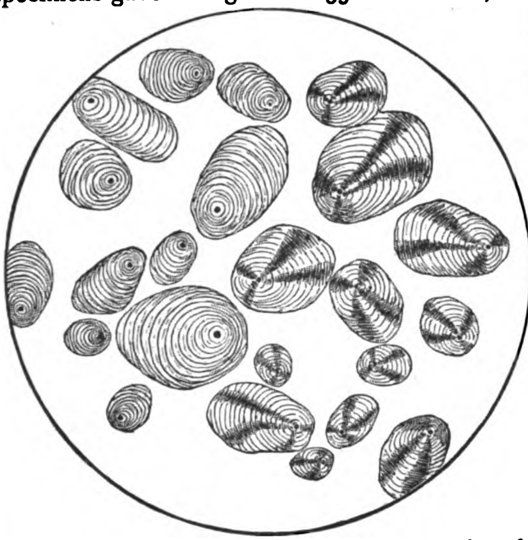


MARANTA STARCH. Drawn with the Camera Lucida, and magnified 250 diameters.

Potato or British arrowroot.—The granules of potato starch are mostly oval or pear-shaped. Some are elliptical and a few, noticeably the smaller granules, are circular. The rings are visible, and in most granules are very distinct. The hilum is seen as a small dot, generally at the narrower end of the granule.

There is considerable variation in the size of the granules. In the specimen from which the accompanying illustration was drawn, they varied from .001 to .0029 of an inch. As already stated this specimen had been mounted for some time. Other measurements made from fresh

specimens gave as high as .0035 of an inch, and some writers give as high as .0055 of an inch. Payen gives the length of the granules of large Rohan potatoes as .0073 of an inch.



Potato starch appears to great advantage under polarized light, because of the large size of the granules and the distinctness of the crosses which they present. By the aid of the selenite plate the colors are shown with remarkable beauty.

POTATO STARCH. Drawn with the Camera Lucida and magnified 250 diameters.

BIBLIOGRAPHY.

Adriani, A.—(1). Detection of Adulterated Flour. Chem. News, 1868, vol. XVII, p. 167.

Allen, A. H.—(2). Poisoning by Mouldy Bread. The Analyst, vol. III, p. 355.

Attfield, J.—(3). Chemistry, General, Medical and Pharmaceutical. 1875, p. 451.

Bala.—(4). Farine de blé adultérée par de la farine de Lathyrus. Union Pharm., 1861, t. II, p. 151.

Barral, J.—(5). Etude analytique sur le blé, la farine et le pain. Compt. Rend., 1863, vol. LVI, p. 834.

Barruel.—(6). Rapport sur un pain fait avec la sciure de bois et la fécule de pommes de terre. Ann. d' Hyg. et de Méd. Lég., 1832, t. VII, p. 198.

Bell, J. C.—(7). Note on the Detection of Alum in Flour. The Analyst, vol. II, p. 28;—(8). Analyses of Flours and Breads. The Analyst, vol. IV, p. 126.

Birnbaum, K.—(9). Das Brodbacken. Eine Besprechung der Grundlagen für den rationellen Betrieb des Bäckergewerbes. Braunschweig, 1878;—(10). Ueber Kleberbrot. Dingl. Poly. Jour., 1879, vol. 233, p. 322.

Blyth, A. W.—(11). Dictionary of Hygiene, London, 1876, Article Bread;—(12). Note on Alum in Bread. The Analyst, 1878, vol. III, p. 274;—(13). Manual of Practical Chemistry, London, 1879;—(14). Improved Processes for the detection of Alum in Flour and Bread. The Analyst, 1882, vol. VII, p. 16.

Bolas, Thos.—(15). On the amount of Alcohol contained in Bread. Chem. News, 1873, vol. XXVII, p. 271.

Bornträger, H.—(16). Einfache und sichere Methode zur Einäscherung der verschiedenen Mehlsorten. Zeitsch. Anal. Chem. 1878, p. 440.

Boudin and Foster—(17). Vegetable Parasites. Archiv. Gen. de Méd. 1848, p. 244.

Bronner, E. and Scoffern, J.—(18). The Chemistry of Food and Diet. London.

Brown, and Heron.—(19). Composition of the Starch-granule. Chem. Sec. Jour., XXXV, p. 610.

Buchner, L. A.—(20). Testing Bread and Flour for Alum. Dingl. Poly. Jour., CCIV, p. 424;—(20 a). Poly. Notizbl., 1872, No. XIV.

Busk, G.—(21). On the Structure of the Starch-granule. Quart. Jour. Microscop. Soc. 1853, vol. I.

Chevallier, A. (22). Sur l'emploi du sel de cuivre dans la fabrication du pain. Ann. d' Hyg. et de Méd. Lég. 1830. 1re série, t. IV, p. 20

—(23). Sur l' influence de certains corps dans la panification, ib. 1840, t. XXIV, p. 82 ;-(24). Le pain dans la confection duquel il entre de la farine de semences de lathyrus cicera, peut-il être nuisible à la santé; ib., 1841, t, XXVI, p. 126; —(25). Pain dans la fabrication duquel on a fait entrer du savon, ib., 1842, t. XXVII p. 306; —(26). Sur le pain moisi, ib., 1843, t. XXIX, p. 39; —(27). Sophistication des farines, ib., 1849, t. XLI, p. 198; —(28). Falsification des farines, ib., 1850, t. XLIII, p. 171; —(29). Altération de farine, ib., 1853, t. XLIX, p. 402; —(30). Pain fait de farine de seigle contenant de l' ivraie. Des accidents chez 80 personnes., ib., 1853, t. l., p. 147; —(31). Falsification du pain et de la farine. Journal d' Hygiène. 1878, May.

Church, A. H. (32). Analysis of Entire Wheaten Flour. Chem. News, 1871, vol. XXIV, p. 100; —(33). Food, 1880.

Cleaver, E. L. (34). New Method for the Detection of Alum in Bread. Pharm. Jour. Trans. (3) vol. IV, p. 851; —(35). The Admixture of Oat meal with Barley meal. The Analyst, vol. I p. 187.

Crookes, Wm. —(36). On the Detection of Alum in Bread. Chem. News, 1861, vol. III, p. 207; —(37). Alum in Bread, ib., 1873, vol. XXVIII, p. 267.

Danckwortt, W. —(38). Examination of Flour. Archiv. der Pharm. (II) vol. 145, p. 47; —(38 a). Zeitsch. Anal. Chem. 1871, p. 366.

Dauglish, John —(39). New system of Bread Manufacture. Chem. News, 1860, vol, I, p. 260.

Davis, Geo. E.—(40). The Logwood Test for Alum in Bread. Chem. News, 1872, vol. XXV, p. 207.

Desnos. —(41). Dictionnaire de Médecine et Chirurgie pratiques.

Dietzsch, O. —(42). Die Wichtigsten Nahrungsmittel und Getränke, etc., Zürich, 1879.

Donny. —(43). Verfahrungsarten zur Entdeckung der Verfälschungen der verschiedenen Mehl-und Brodarten. Dingl. Poly. Jour. 1847. vol. CV, p. 448.

Dragendorff. —(44). Ergot of Rye. Pharm. Jour. Trans. 1876, No. CCCXII, p. 1001.

Drewry, G. O. and Bartlett, H. C. —(45). Cup and Platter London, 1876.

Dubuc. —(46). Ueber ein mechanisches und chemisches Verfahren, um die Verfälschung des Getreidemehles zu erkennen. Dingl. Poly. Jour. 1834, vol. LIII, p. 443.

Dunin, M. —(47). Examen des farines. Archiv. der Pharm. (III) t. VIII, p. 513.

Dupré, A. —(48). On the Estimation of Alum in Bread. Chem. News, 1874, vol. XXIX, p. 233; —(49). Preliminary Note on the Detection of Alum in Bread. The Analyst, 1878, vol. III, p. 283; —(50). On the Detection and Estimation of Alum in Wheat-flour. Ib. vol. IV, p. I.

Dussance, H. —(51). On the Adulterations and Falsifications of Bread. Chem. News, 1868, vol. XVII, p. 268.

Edmunds, James —(52). Ultramarine. Its Formation during the Incineration of Bread. Chem. News, 1875, vol. XXXII, p. 311.

Elsner, F. (53). Die Praxis des Nahrungsmittelchemikers. Leipzig, 1880.

Eulenberg, H. und Vohl, H.—(54). Ueber Brodvergiftung. Dingl. Poly. Journ., 1870, CXCVII, p. 530.

Fassbender, R.—(55). Ueber Brodvergiftung. Dingl. Poly. Jour., vol. CCVI, p. 475.

Fisher, F.—(56). Ueber Mehluntersuchung. Dingl. Poly. Jour. vol. CCXXXI, p. 85.

Flückiger, F. A. and Hanbury, D.—(57). Arrowroot, its Nature, Adulteration and Examination. Pharmacographia, 1879, p. 629.

Fox, C. B.—(58). Sanitary examinations of Water, Air and Food, 1878.

Gaultier de Claubry, H.—(59). Note sur une altération particulière observée sur le pain. Ann. d'Hyg. et de Méd. Lég., 1843, t. XXIX, p. 347;—(60). Les moyens de reconnaître dans la farine de froment le melange de substances étrangères. ib., 1847, t. XXXVIII, p. 151;—(61). De l'altération du pain par diverses espèces de champignons. Bull. de l'Acad. de Méd. 1871, t. XXXVI, p. 729.

Hadow, E. A.—(62). Notes on Alum in Bread, and its Detection. Journal Chem. Soc., 1858, vol. X, p. 103; (62a), the same, Chem. News, 1862, vol. VI, p. 146.

Hager.—(63). Verfahren um Extracte, Nahrungsmittel, etc. auf Kupfer zu prüfen. Pharm. Centralblatt, 1863, No. XXXV;—(63a). Dingl. Polyt. Jour., CLXXIII, p. 159.—(64.) Das Mikroskop und seine Anwendung. Berlin, 1879.

Hartig.—(65). Bau des Stärkemehles. Wien Akad. Ber. 2te. Abth. LXIII, 505;—(65a). Jahresb. f. Chem. 1871, 789.

Hartwich.—(66). Sur le pain coloré en bleu par la rhinanthine. Archiv. der Pharm. Oct. 1880;—(66a). Jour. Pharm. et de Chim., 1880 5e sér. t. II, p. 484.

Hassall, A. H.—(67). Food. London, 1876.

Hock, M.—(68). Bestimmungen der längen Dimensionen von Stärkekörnern. Jahresb. Chemie. 1872, p. 1021.

Hoffmann, E.—(69). Ueber den Nachweis von Mutterkorn (Secale cornutum) im Mehl. Pharm. Zeit., vol. XXIII, pp. 726 and 742;—(69a). Zeit. Anal. Chem. 1879, vol. XVIII, p. 120.

Horsley, J.—(70). On Alum in Bread and Flour. Chem. News, 1861, vol. IV, p. 326;—(71). On the Question of Alum in Bread. Chem. News, 1862, vol. VI, p. 251;—(72). Also vol. VII, 1863, p. 286;—(73). The Logwood Test for Alum in Bread. Ib., 1872, vol. XXV, p. 230;—(74). Adulteration of Flour and Bread. Archiv. der Pharm. July and Dec. 1873.

Johnson.—(75). Cyclopædia. Vol. I, p. 596. Article, Bread.

Johnston, J. F. W.—(76). The Chemistry of Common Life. Edited by A. H. Church. New York, 1880.

Klencke, H.—(77). Die Verfälschung der Nahrungsmittel und Getränke. Leipzig, 1858;—(78). Lexicon der Verfälschungen der Nahrungsmittel und Getränke. Leipzig, 1879.

Knights, J. W.—(79). On the Action of Alum in Bread Making. The Analyst, vol. V, p. 67;—(80). Alum: Its Effects upon the System when introduced into Bread and Pastry by the Use of Alum Baking Powder, etc. pph., 1880.

König, J.—(81). Die menschlichen Nahrungs und Genussmittel. Berlin, 1879 and 1880. Vols. I and II.

Kuhlmann.—(82). Considérations sur l'emploi du sulfate de cuivre et

de diverses matières salines dans la fabrication du pain. Ann. d'Hygiène et de Méd. Lég. 1831, t. v, p. 339.
Lankester, Ed.—(83). On the Adulteration of Food. Chem. News, vol. I, p. 196.
Lawes, J. B. and Gilbert, J. H.—(84). On some Points in the Composition of Wheat-grain, its Products in the Mill, and Bread. Jour. Chem. Soc. 1858, vol. x, p. 269.
Letheby, H.—(85). On Food. London, 1872.
Liebig, J.—(86). Chemische Briefe. Heidelberg, 1851;—(87). Sur le pain chimique. Jour. Pharm. et Chim. IVe sér. 1868, t. VII; from Allgemeine Zeitung, 1868, No. 11 Suppl.
Ludwig, H.—(88). Examination of Flour. Archiv. der Pharm. (II), vol. CXLVII, pp. 1–27.
Mege-Mouriès.—(89). Cerealine. Compt. Rend., t. XXXVII, p. 775; (90). Ib., t. XXXVIII, p. 351;—(91). Ib., t. XXXVIII, p. 505;—(92) Ib., t. XLII, p. 1122; (93) Ib., t. XLIV, p. 40; (94). Ib., p. 449; (95). Ib., t. XLVI, p. 126; (96). Ib., t. XLVII, p. 431; (97). Ib., t. l. p., 467.
Moffat, R. C.—(98). The Detection of Alum in Bread. Am. Chem. vol. I., p. 365.
Moitessier, A.—(99). De l'emploi de la lumière polarisé dans l'examen microscopique des Farines. Ann. d'Hyg. et de Méd. Lég. 1868, t. XXIX, p. 382.
Mott, H. A.—(100). The Effects of Alumina Salts on the Gastric Juice of the Process of Digestion. Jour. Am. Chem. Soc., vol. II, No. 1.
Mott vs. Burns.—(101). Superior Court of the City of New York, 1879.
Muspratt.—(102). Dict. of Chem., vol. I, p. 353. Article, Bread.
Muter, J.—(103). Classification and Detection of Starches. The Analyst. Vol. I, p. 172; (103a) the same, Organic Materia Medica. 1879, p. 473.
Nägeli, C.—(104). Die Stärke-Mehlkörner. Zürich, 1858.
Nägeli, W.—(105). Stärkegruppe, etc. Leipzig, 1874.
Naquet, A.—(106). Legal Chemistry. Translation by J. P. Battershall, 1876, p. 114.
Norfolk Baking Powder Case. (107). The Analyst. Vol. IV, p. 231; (107a) Ib., vol. v, p. 21.
Normandy, A.—(108). Commercial Handbook of Chemical Analysis, 1875. Edited by H. M. Noad.
Odling, W.—(109). Jour. Soc. Arts., April 9, 1858.
Orfila, P.—(110). Des questions médico—légales concernant l'alun calciné. Archiv. Gen. de Méd. (1re sér.) 1829, t. XIX, p. 514; (111). Sulfate de cuivre dans le pain. Ib., Mars, 1829, t. XIX. (111a) Ann. d' Hyg. et de Méd. Lég., 1829, t. I, p. 297.
Oser, T.—(112). Einfache Prüfung des Mehls. Dingl. Poly. Jour. 1867, vol. CLXXXIII, p. 256.
Parkes, E. A.—(113). A Manual of Practical Hygiene. Edited by F. de Chaumont. London, 1878.
Patrick G. E.—(114). Alum in Baking Powders. Scientific American, Supplement, July 19, 1879.
Pattinson and Stead.—(115). Estimation of Barley in Oatmeal. Chem. News, 1876. Vol. XXXIV, p. 194.

Pavy, F. W. — (116). A Treatise on Food and Dietetics. London, 1875.

Payen, A. — (117). Altération du pain. Compt. Rend. Juillet, 1848; (118). Précis de Chim. Indust., 2me ed., 1851, p. 446. Articles, Farine, Pain.

Penney, M. D. — (119). Alum in Flour and Bread. Chem. News, 1879. Vol. XXXIX, p. 80.

Pereira, J. — (120). A Treatise on Food and Diet, etc. London, 1843; (121). Elements of Materia Medica and Therapeutics. Edited by Bently and Redwood, London, 1874.

Petri. J. — (122). Detection of Blighted Wheat in Flour by the Spectroscope. Zeit. Anal. Chem. 1879, p. 211.

Pietra Santa, P. de — (123). Alum in Bread Making. Sanitary Engineer, 1881, vol. v, p. 66.

Pocklington, H. — (124). Some Starches microscopically and polariscopically considered. Pharm. Jour. Trans., 1873, (3), vol. IV, p. 352. (125). Some practical Applications of Polarized Light. Ib., 1875–76, vol. VI, pp. 662 and 741.

Poggiale. — (126). Sur une altèration speciale et extraordinaire du pain de munition. Jour. Pharm. et Chim. (4me sér.). 1871, t. XIV, p. 98.

Puscher, C. — (127). Ueber die Verfälschung des Mehls und der Weizenstärke mit Kartoffelstärke.

Ricquet. — (128). Un cas d'empoisonnement par l'alun. Jour. Pharm. et. Chim. (4me sér.), 1873, t. XVIII.

Rimmington, F. M. and Geo. — (129). The Detection of Alum in Flour and Bread. The Analyst, vol. III, p. 307.

Ritthausen, H. — Upon Vegetable Gluten in General, (130). Jour. Prac. Chem. 1862, vol. LXXXV, p. 193;—(131). Ib., 1862, vol. LXXXVI, p. 257;—(132). Ib., 1863, vol. LXXXVIII, p. 141;—(133). Ib., 1864, vol. XCI, p. 296;—(134). Ib., 1866, vol. XCIX, p. 439;—(135). Ib., 1868, vol. CIII, p. 65;—(136). Ib., vol. CIII, p. 193;—(137). Ib., 1868, vol. CIII, p. 233;—(138). Ib., vol. CIII, p. 273.

Rivot. — (139). Note sur l'examen des farines et des pains. Ann. de Phys. et de Chim. (3e sér.) 1856, t. XLVII;—(139a) Dingl. Poly. Jour., vol. CXLIII, p. 380.

Rochard, F. et Legros, C. — (140). Du parasitisme végétal dans les altérations du pain. Compt. Rend., 1872, t. LXXV, p. 758.

Ross, Major. — (141). On the Blue Color sometimes produced in the Incineration of Bread. Chem. News, 1876, vol. XXXIII, p. 36.

Rummel, F. — (142). Das Roggenbrod und seine Verfälschungen. Dingl. Poly. Jour. 1856, t. CXXXIX, p. 49.

Schönn. — (143). Bestimmung der mittleren Grösse der Stärke-mehlkörner. Dingl. Poly. Jour., 1870, vol. CXCV, p. 469.

Skalweit, J. — (144). Ueber Mehlverfälschungen. Dingl. Poly. Jour. 1878, vol. 227, p. 571.

Smith, Ed. — (145). Foods. New York, 1873.

Stoddart, W. W. — (146). On the Logwood Test for Alum. The Analyst. Vol. IV, p. 7.

Thresh, J. C. — (147). New Method of Detecting and Estimating Alum in Bread and Flour. Pharm. Jour. Trans. (3), vol. v, p. 885;—(147a) Jour. Pharm. et Chim. (4e sér.), 1875, t. XXII, p. 312.

Thomas, J. W.—(148). Alum in Flour. The Analyst, vol. IV, p. 32.
Trébuchet, A.—(149) Exposé des recherches du conseil de salubrité de Paris, de 1840 à 1845 Ann. d' Hyg. et de Méd. Lég. (1re sér.) 1847, t. XXXVIII, p. 86.
Tripe, J. W.—(150). On the Discrimination of Starches by Polarized Light. The Analyst, vol. IV, p. 221.
Ure.—(151). Dict. Arts, etc., vol. I, p. 246. Article, Bread.
Vogl, Aug.—(152). Nahrungs- und Genussmittel, aus dem Pflanzenreiche. Wien, 1872.
Vohl, H.—(153). Detection of Foreign Mineral Substances in Flour. Deut. Chem. Ges. Ber., vol. IX, p. 1660.
Wanklyn, J. A.—(154). How to test Flour and Bread. Pharm. Jour. Trans. (3), III, p. 827;—(154a) Ib., Archiv. der Pharm., Dec. 1873;—(155). On the Detection of Alum in Bread. Chem. News, 1875, vol. XXXI, p. 66 (155a) Ib., Proc. Soc. Pub. Analysts, 1876. vol. I, p. 8.
Wanklyn, J. A. and Cooper, W. J.—(156). Bread Analysis. London, 1881.
Watts, Henry—(157). A Dictionary of Chemistry, vol. I, p. 656. Subject, Bread; (158). Detection and Estimation of Alum in Flour and Bread, Ib., III, Suppl. part I, p. 67;—(159). Article, Flour, ib., p. 792.
Welborn, G.—(160). Detection of Alum in Bread and Flour. Pharm. Jour. Trans. (3), vol. IX, p. 181.
Wiesner, J.—(161). Einleitung in die Technische Mikroscopie. Wien, 1867. (162). Mikroskopische Untersuchungen. Stuttgart. 1872.
Young, W. C.—(163). On the Estimation of Alum in Bread. The Analyst, vol. II, p. 13;—(164). Note on the Detection of Alum in Flour by the Logwood Test; ib., vol. IV, p. 6; (165). Bread Fungus. Am. Chem., vol. II, p. 399; (166). Ueber die Auffindung des Weizenmehls im Roggenmehl. Pogg. Annalen, 1852, vol. LXXXV, p. 161; —(166a), Ib., Dingl. Poly. Jour. 1852, vol. CXXIII, p. 377.

Group V.

Canned Fruits and Vegetables; Preserves; Vinegar; Pickles; Mustard; Ginger; Spices; Antiseptics employed in preserving; Glazing and Enamel, as affecting Food-Articles.

Also Group VII.

Tea; Coffee; Cocoa.

By S. A. Lattimore, Ph. D.

Rochester, N. Y., *February* 7, 1882.

Dr. C. F. Chandler,

Chairman Sanitary Committee State Board of Health:

Dear Sir—I have the honor to report to you that three hundred and forty-three samples of food articles have been, under your direction, submitted to me for examination.

The following tabular statement exhibits the names of the articles, the number of samples of each, and the result of the examination.

Group V. — *Canned fruits and vegetables.*

	No. unad'd.	No. adul'd.	Whole No.
Peaches	2	0	2
Plums	1	0	1
Grapes	1	0	1
Strawberries	2	0	2
Cherries	1	0	1
Blackberries	1	0	1
Olives	1	0	1
Mushrooms	1	0	1
Corn	1	0	1
Beans	2	0	2
Succotash	1	0	1
Tomatoes	1	0	1
Pumpkin	1	0	1
Peas	2	0	2
Vinegar	4	0	4
Pickles	8	1	9
Mustard	6	12	18
Ginger	6	9	15
Allspice	8	19	27
Cinnamon	4	18	22
Cassia	3	4	7
Cloves	5	16	21
Black Pepper	12	28	40
White "	2	5	7
Red "	5	5	10
Mace	4	4	8
Nutmeg	3	2	5

GROUP VII.— *Tea, Coffee, etc.*

	No. unadul'd.	No. adul'd.	Whole No.
Coffee, raw	30	5	35
" roasted, unground	3	0	3
" " ground	2	19	21
" extract, essence and surrogate	0	3	3
Tea, green	43	0	43
" black and mixed	18	0	18
Cocoa, and chocolate	6	0	6
Chicory	2	1	3

The word adulteration is here employed in the broad sense, including both substances injurious to health, whether present by accident or design, and substances which are not positively injurious to health, but manifestly added for the purpose of cheapening the cost to the manufacturer and defrauding the consumer.

No indication of adulteration was found in any of the canned fruits and vegetables. Attention was given to the possibility of the chemical re-action of the fruit acids upon the inner surface of the cans, whereby salts of tin and lead might be produced, rendering the contents in some degree poisonous. The application of the well-known tests for these metals failed to show any evidence of their presence. Some of these articles had been canned in the summer of 1880.

The four samples of vinegar were all of inferior quality, being deficient in acetic acid, but free from mineral acids, and must be classed as unadulterated, unless an excess of water may be considered an adulteration.

The nine samples of pickles gave no evidence of the presence of copper or other metal. The only sample which possessed a suspiciously green appearance was found to contain alum.

The remaining articles under Group V may be treated together for the sake of brevity. As the table shows, a large proportion of them are adulterated, and that with substances presenting a certain uniformity. The spices present an inviting field for the exercise of fraudulent arts. They are almost universally sold in the form of fine powder, and in opaque packages, which do not admit of easy examination on the part of the purchaser. Consequently any cheap substance which may be easily pulverized to a similar degree of fineness, and which possesses little distinctive taste or odor of its own, answers the purpose; so that the list of adulterants for this class of articles is naturally very large. The adulterations found in the samples now under consideration may be classed into four groups. First: integuments of grains or seeds, such as bran of wheat and buck-wheat, hulls of mustard seed, flax-seed, etc. Second: farinaceous substances of low price, and such as are damaged by the accidents of transportation or long storage, such as middlings of various kinds corn-meal, and stale ship's bread. Third: leguminous seeds, as peas and beans, which contribute largely to the profit of the spice mixer. Fourth: various articles chosen with reference to their suitableness for bringing up the mixture as nearly as possible to the required standard of color of the genuine article. Various shades, from light colors to dark browns, may be obtained by the skillful roasting of farinaceous and leguminous substances. A little turmeric goes a great

way in imparting the rich yellow hue of real mustard to a pale counterfeit of wheat flour and terra-alba, or the defective paleness of artificial black pepper is brought up to the desired tone by the judicious sifting in of a little finely pulverized charcoal. Enough has been already given to show that the field for sophistications of this sort is a wide one, and offers large scope for the development of inventive genius; so that each manufacturer of articles of this class would be likely to possess his own trade secrets. It will be observed that the adulterating materials just mentioned all belong to the class claimed to be harmless. In no instance has any poisonous substance been discovered. The proportion of foreign and genuine substances in the spices varies between wide limits, in some instances the former being slight, in others, the latter seemingly present in just sufficient quanity to impart faintly the requisite taste or odor. Even this small proportion of the professed article is occasionally still further diminished by the substitution of other substances, as, for example, in imparting to corn meal finely ground, a pungency suggestive of real ginger by the addition of a little salt and red pepper.

Group VII.

Thirty-five samples of unroasted coffee have been received. In five packages, a few grains were discovered which had been slightly colored or faced. A minute quantity of blue pigment adhered to the more prominent parts of the bean, giving a somewhat brighter color to the coffee when viewed in the mass. It was apparently Prussian blue, the quantity obtained being too minute to permit satisfactory chemical tests. No lead chromate could be recognized. This coloring matter would all doubtless be separated from the coffee in the process of roasting when it is revolved in a wire cage over the fire. The coffee thus colored was of inferior quality and offered room for improvement. The three samples of roasted, unground coffee were of excellent quality and free from any admixture of foreign substance. The ground coffee, sold in packages, as the statistics show, was all, excepting two packages, more or less sophisticated. The foreign substances were generally found to be chiccory, beans, and less frequently, wheat or other grain coarsely ground. In one package marked coffee, with an ingeniously ambiguous qualification, no coffee at all was found, but roasted hominy. Three samples, labelled coffee-extract, coffee essence, and coffee surrogate, were composed chiefly of caramel and liquorice, and contained no coffee.

Forty-three samples of green tea, and eighteen of black tea have been received. Many of these are of the cheapest and most inferior quality, some of them mere tea-rubbish, yet no leaf, or fragment of a leaf, which has been examined could be considered any thing but tea. As to mineral matter I have not succeeded in detecting any thing which may not perhaps be fairly credited to the rude and careless manner in which it is handled by the rough employees of the tea farm. Neither have any positive evidences been discovered of the admixture of exhausted leaves. If they are present, the admixture is too slight to render detection possible by determination of the percentage of extract of tannin.

Of cocoa, and its preparations, one sample of cocoa nibs, and five of chocolate, were received. The latter being a professedly manufactured and mixed article, for which there is no standard formula, it could not properly be considered adulterated.

Three samples of chiccory have been examined one of which was mixed with caramel and is therefore entered as adulterated.

Methods of Examination.

It unfortunately happens that in case of the great majority of food articles included in groups V and VII, the only positive means of demonstrating the presence of foreign substances requires special skill in the application of chemical knowledge or in the use of the microscope. Hence, any elaborate discussion of the detailed examination of each class of articles would be without value or interest to the public, and also to the expert chemist and microscopist, as I have found the usual and well-known methods of investigation fully adequate. The examination of canned fruits and vegetables for copper, tin, and lead, possibly derived from the metallic vessels in which they are prepared and preserved, is of course purely chemical. The search for foreign vegetable substances in the spices, coffee and tea, can depend only in a limited degree on chemical analysis, since many of these substances, however widely different in general appearance, and even in origin, are but slightly differentiated in their chemical properties. This difficulty, however, is most fully compensated by the marvellous variety of structure every where visible in all vegetable tissues. However similar the fruit, seeds, or leaves of two plants, even of the same order or genus, some constant and invariable difference of structure is sure to be found, which constitutes, in such investigations as these, the means of their instant and certain distinction. The eye must first be made familiar by patient practice with the structural characters of the genuine article, which is to serve as the standard of comparison. This being accomplished, a foreign fragment is instantly distinguished as foreign, whether its identity can be ascertained or not. Even this is an important step in the examination of a food article. But as these stranger forms are likely to occur frequently, and are not very numerous relatively, they are soon traced to their origin. Hence to the microscopist the discrimination, for example of the starch grains of the various starch bearing tubers, grains and seeds, is as simple and, in fact, of precisely the same sort as the discrimination of the various fruits of the garden by the ordinary observer, who has acquired this power by repeated, though perhaps unconscious, comparisons.

The detection of the more common adulterations of ground coffee, presents an exception in some degree to the remarks just made, arising from two differences of the roasted bean from the substances commonly found mingled with it. The roasted coffee bean softens very slowly in water, while leguminous and farinaceous substances soften rapidly — it very slowly colors the water on which it floats or in which it sinks, while they generally sink more readily, and rapidly impart a brown color to the water. Hence by a little practice in crushing beneath the point of a knife, or between the teeth, genuine coffee and fragments of chiccory, roasted peas, beans, etc., both having been previously well moistened, a very marked difference will be perceived and which may be found of much practical use. The widely published method of discriminating coffee from chicory, by the circumstance that the former will continue to float on cold water while the latter will rapidly sink, I have not found to be a trustworthy test. In this case, as in the others, however, the microscope constitutes the court of final resort.

Those who are interested in the detection of food adulterations by means of the microscope, will derive great assistance in the beginning of their work from the engravings and descriptions of microscopic structure contained in Dr. Hassall's elaborate treatise on *Food; its adulterations, and the methods for their detection; Bell's Analysis and Adulteration of Foods*, and other such books. The study of engravings, however, must not be expected to take the place of the vegetable tissue itself for practical purposes.

Spice Mixtures.

In addition to the samples of food articles already mentioned, I have also received a considerable number of the so-called *spice mixtures*. It is probably not so widely known as it should be, that the demand for the materials for adulteration has called into existence a branch of manufacturing industry of no insignificant magnitude, having for its sole object the production of articles known as *spice mixtures*, or *pepper dust*. The use of pepper dust, or as the article is commonly designated in the technical language of the trade, by its abbreviation, "P. D." is a venerable fraud. So long ago as 1820, when Frederick Accum made his memorable revelation in London, by the publication of his book on the *Adulterations of Food and Culinary Poisons*, he observed that "ground pepper is very often sophisticated by adding to a portion of genuine pepper, a quantity of pepper dust, or the sweepings from the pepper warehouses, mixed with a little cayenne pepper. The sweepings are known, and purchased in the market under the name of P. D., signifying pepper dust. An inferior sort of this vile refuse, or the sweepings of P. D., is distinguished among vendors by the abbreviation D. P. D., denoting dust (dirt), of pepper dust." P. 286. Indeed, much of this curious old and somewhat rare book reads as if it had just been written.

The manufacture of P. D. is now a regular branch of business, and the original and specific term pepper dust has expanded with the progress of inventive art to gigantic proportions, until now we have, as well known articles, sold by the barrel, "P. D. Pepper," "P. D. Ginger," "P. D. Cloves," and so on through the whole aromatic list. When it is considered that these imitations, lacking only such flavoring with the genuine article as the dealer thinks necessary to make his goods sell, are sold at from *three to four cents a pound*, and the retail price paid by the consumer is compared with it, the strength of the temptation to engage in such practices is clearly seen. When manufacturers openly advertise themselves as *assorters and renovators of merchandise*, and openly propose *to cleanse musty and damaged beans by a new and patented process*, it is full time that its significance should be considered by the public.

Manufactured Food Articles.

In the progress of this investigation, the subject of permitting the manufacture and sale of certain articles deprived of some of their natural constituents, or with the addition of certain substances, has frequently occurred. For example; mustard is generally deprived of its fixed oil in the process of manufacture, and is improved for all ordinary uses thereby. A similar practice is now extensively applied to cloves which

are not likewise improved, but robbed of the very constituent on which their value depends. It is proposed to sell mixtures of chiccory and coffee as such, stating the proportions of each on the package, so that no one shall be deceived. To this, and, in fact, to all similar propositions, it is to be objected, that advantage would immediately be taken of the fact that it would generally be difficult in the extreme, and, in some cases at least, absolutely impossible, to establish the fact in a court of justice, whether a definitely fixed proportion had been exceeded or not. Bearing in mind the wide difference between the ease of demonstrating, often by diverse methods, that a foreign substance *is present*, and the difficulty of demonstrating absolutely *its percentage by weight*, it will be plain how greatly the administration of the law would be simplified which should prohibit the manufacture and sale of all mixtures, with possibly a few exceptions, leaving to the consumer the privilege and pleasure of suiting his own tastes. Protection and even indorsement is claimed for some of these most worthless mixtures, on the ground that they are *harmless*, while the fact that they are counterfeit articles, as really as is a fictitious bank bill, is studiously left out of consideration. The simplest and best way is to require that things shall be called by their right names.

Very respectfully,

S. A. LATTIMORE.

Group VI.

Sugars; Syrups; Molasses; Glucose; Confectionery; Honey, and Soda-Water Syrups.

By W. H. Pitt, M. D.

To the Chairman of the Sanitary Committee of the State Board of Health:

Sir — I have the honor to make the following report on the group assigned me for investigation.

Glucose.

Since the glucose or starch sugar is now so largely manufactured, and finds a ready sale to brewers, sugar dealers and confectioners, I have devoted my attention especially to it. Although artificial glucose has been manufactured to a considerable extent in some of the countries of Europe for thirty or forty years, it is only within a comparatively short time that it has found a market in the United States. Considered as a sugar, it is entirely different from that made from the sugar cane. It is natural then, that consumers should look with no little degree of suspicion upon this starch product called glucose, which is sometimes mixed with cane sugar, and which is also extensively used in the manufacture of syrups, honey, and confectionery.

Physiologically considered, glucose, pure and uncontaminated with other compounds, is certainly a good and wholesome food.

As the question is often asked whether artificial glucose contains injurious compounds arising from the chemicals used in its manufacture, or produced from the starch itself, I have taken pains to examine its mode of manufacture, and have also made chemical analyses of several different varieties.

The following table shows the percentage of starch in several vegetable products, according to Krockers's Analysis:

	Starch.	Protein.	Fat.	Ash.	Fibrin.	Water.
Wheat	63.3	14.4	1.9	1.7	4.2	14.5
Rice	74.5	7.8	0.2	0.3	3.4	13.7
Corn	64.5	9.9	6.7	1.4	4.0	13.5
Potatoes	20.0	...	...	..	...	76.0

All efforts of the synthetical chemist to produce a substance having the properties of starch have proved unsuccessful; but he is enabled by chemical reagents to so act upon starch itself, that kindred products are obtained such as dextrine or starch gum, grape sugar or glucose. In 1811, Professor Kirchhoff, a Russian chemist, discovered that if starch paste be boiled for a certain time with a little sulphuric acid, a part of the starch is converted into starch sugar or glucose. From that time to the present, notably in Austria and Germany, the manufacture of glucose has been carried on with varied success. It is only within a few years, however, that this new branch of industry has developed to the enormous extent at present seen in the factories at Buffalo, Chicago, St.

Louis, and Peoria. The daily average consumption of corn in the American and in the Buffalo factories is 14,500 bushels, giving employment to 1,200 men, 300 or 400 of whom are kept at work making barrels and boxes for shipping the product.

From January 1, 1880 to January 1, 1881, the actual amount paid for work and labor by these two companies in the city of Buffalo was $983,-488.96. Less than one per cent of the quantity produced was sold in Erie county. The Firmenich factory uses 4,000 bushels of corn daily, and gives employment to about 400 men. We have in the aggregate, then, in these three factories a daily consumption of 18,500 bushels of corn, and employment given to 1,600 men.

It should be observed that starch in green fruits is changed into sugar during the process of ripening. In seeds, however, which contain the embryo plant, it is stored up mostly unchanged for the future growth of the plant. But as starch is insoluble in water at common temperatures, it could evidently in this state furnish no nourishment for the early stages of cellular growth. To render this universal plant food assimilable, nature has provided another substance, also in the plant, which contains nitrogen in addition to the elements of which starch is composed. This material of a variety of forms, is called the nitrogenous portion of the plant, and is very unstable or prone to change. In its decomposing condition it is called diastase. This so called diastase has the property when brought in contact with starch of changing it into glucose, which dissolves in water and is the chief food supply of the young plant. In imitation of the natural metamorphosis of starch, the chemist can bring about precisely the same change by adding dilute acids or malt. If starch-paste be boiled in water for a long time glucose is also said to be formed. The extremes of temperature 350 deg. Fahrenheit and 32 deg. Fahrenheit, acting upon starch, will convert small quantities of it into glucose. Boiling with almost any of the dilute acids has the same effect.

In this conversion, however, all of the starch does not become sugar, no matter what process may be used. When a certain proportion of sugar is produced, it appears to arrest further action. The remaining part of the starch, or at least the most of it, becomes dextrine or starch gum. Herein lies the great annoyance with which the manufacturers of glucose have to contend. It is hardly possible to make two samples of glucose containing a like amount of saccharine matter. Each time there will be more or less glucose, according to the quantity of starch gum produced at the end of the conversion. There will always be found, then, dextrine or starch gum in the sugar and syrup made from starch.

It is true that by careful management, converting under pressure, lessening the time, etc., the quantity of gum can be reduced to a minimum, but still it can always be detected, and forms a considerable percentage of the article sold as artificial glucose. The starch gun or dextrine is very easily converted into glucose after the sugar in solution is removed; but as it is also dissolved in the water, the cost of chemicals and the skill requisite for its removal make such an operation very unprofitable.

The dextrine when taken as food, and also the starch itself, are changed into glucose by the fluids of digestion, the action being apparently the same as in the case of diastase or dilute acids.

It is evident that the artificial production of glucose from starch by the acid process, the one in general use, can be most profitably carried on by using those grains, tubers, or roots which contain the starch in

the greatest quantity. Corn is found, from its abundance and high percentage of starch, to be the best material for this purpose in the United States ; but potatoes for a like reason, are mostly used in Europe. The process of conversion is essentially the same after the starch is extracted, although modified in detail according to the idea of different manufacturers in endeavoring to produce sugars of marketable grades. The following brief description of the manufacture of glucose as practiced at the American Grape Sugar Co.'s Factory, at Buffalo, may aid in obtaining a knowledge of the process.

The corn is steeped in water for fifty or sixty hours, during which time the water is repeatedly drawn off, and a fresh supply added every ten hours. About 1,000 bushels of corn are treated in each operation. After having been sufficiently steeped, it is thoroughly washed with a new supply of clean water, to rid it of all albuminoids or fermentable substances. While still in a moist condition it is ground by common mill-stones, and the resulting pasty mass is placed on sieves which are kept supplied with water. By this treatment the starch is washed through the sieve, while the coarser material, including the glutinous portion and about 50 per cent of the starch, is retained on the sieves. The wet bran, after being thoroughly dried, forms a perfectly wholesome and nutritious food for animals. In quantity it averages about eight pounds per bushel of corn used.

The starch which passes through the sieves is then run into settlers, which are cylinders ten feet in diameter, and eight or ten feet high, and allowed to settle four to six hours. After the starch has completely settled the supernatant water is run off as waste. The starch is then treated with a solution of sodic hydrate, to rid it of any remaining nitrogenous substances, after which the alkaline starch is drawn into shallow vats or tables, 100 feet long and allowed to settle. It is then washed repeatedly to remove the alkali, the operation requiring about sixty hours. Up to this stage of the process, a glucose factory is essentially the same as a starch factory. Fresh water is again added to the clean starch, and the whole mixture drawn off into the wooden converters. The temperature is raised to 100 deg. C. (212 Fahrenheit), and to the starch paste from one and one-half to two per cent of sulphuric acid are added, and the whole boiled for about three hours. At the end of this time the starch, or as much of it as possible, has been converted into glucose, and dissolved in the acid water.

It is not found in practice desirable to continue the acid treatment any longer or at higher temperatures, as the acid may so act upon the sugar formed as to produce traces of other compounds giving the sugar a bitter taste, etc. The acid sugar solution is now treated with marble dust or chalk, which combines with the acid, forming calcic sulphate, —gypsum, which, being insoluble; settles to the bottom, leaving the clear "sweet water" in a nearly neutral condition. To remove the last traces of sulphuric acid, lime cream is added until the test shows no free acid.

The settling of the gypsum requires from four to five hours. It is also subjected to other purifications, the details of which need not be stated here as they are merely mechanical, until the solution is as pure as possible. The sweet liquor is filtered through a filter press, at 15 deg. Baumé, after which it is filtered through bone-black filters and undergoes other purifications. It is then boiled *in vacuo,* at 130 deg. Fahren-

heit, to 40 deg. Baumé. This is common glucose, and is ready for shipment in barrels holding five or six hundred pounds. The above, mixed with 5-10-15-25 per cent of cane syrup to give it color and more sweetness, in the syrup of the grocers, and retail dealers—an analysis of which is here appended.

AMERICAN GRAPE SUGAR CO.'S SYRUP.

Analysis of mixed Glucose syrup.

Ash	.820
Water	18.857
Starch gum or dextrine	34.667
Cane syrup	7.805
Glucose	37.851
	100.000

This syrup has slight acid reaction, which arises from the cane syrup as before mixing the glucose is neutral.

The confectioner's glucose is made the same as the above, with additional purification, and finished for market by evaporating to 42 deg. to 43 deg. B. It has a specific gravity of nearly 1.5, and is remarkably transparent, resembling molten glass, which probably gives it the name of "Crystal Glucose." It will not, at an ordinary temperature, run from a common bottle, so viscid and semi-solid is its nature.

AMERICAN GRAPE SUGAR CO.'S CONFECTIONER'S GLUCOSE.

The following is an analysis.

Ash	.431
Water	15.762
Starch gum or dextrine	41.614
Glucose	42.193
	100.000

The solid glucose or grape sugar is made in copper converters under a pressure of 50 pounds per square inch, which brings about the transformation in a much shorter time than by an outside conversion under the common atmospheric pressure. It affords a greater amount of saccharine matter, and consequently less starch gum, as shown by the following analysis:

BUFFALO GRAPE SUGAR CO.'S GRAPE SUGAR, OR SOLID GLUCOSE.

Ash	.768
Water	17.169
Dextrine	14.055
Sugar, Glucose	68.008
	100.000

The sample from which I made the above analysis, is probably about a fair average of what is denominated "70 per cent sugar." But I find this sugar varying from 68 per cent, to 70 per cent or even 72 per cent in saccharine matter. A sugar of about this grade, but harder, is made at the Firmenich factory, and finely cut or grated.

SUGAR.

Fifteen samples of sugar purchased in New York city were submitted to examination.

The water was determined by drying at 100 deg. C; the ash by igniting with sulphuric acid and deducting one-tenth (the French method) the glucose by Fehling's solution ; the cane sugar by difference. The "glucose" includes dextro-glucose and lævo-glucose ("inverted sugar"); no attempt was made to ascertain whether any artificial dextro-glucose had been added by the refiner. From the low precentage of glucose in all the samples I should infer that none of these samples had been adulterated.

RESULTS OF ANALYSES OF SUGAR.

No. of Sample.	Description.	Color.	Retail price per lb.	Water.	Ash.	Glucose.	Cane Sugar.
313	"A"	White	11 cts.	1.500	.036	.890	97.574
314	"A"	White	11 "	1.640	.721	1.000	96.639
315	Powdered	White	12 "	.800	.090	.000	99.110
316	Extra C	Light brown	10 "	5.000	.450	4.000	90.106
317	Extra C	Light brown	11 "	3.600	.666	4.878	90.856
318	Extra C	Light brown	10 "	3.500	.486	3.780	92.234
319	Extra C	Light brown	10 "	3.400	.486	3.636	92.478
320	Extra C	Light brown	10 "	3.720	.360	7.092	88.828
321	Extra C	Light brown	10 "	3.820	.918	6.250	89.012
322	Extra C	Light brown	10 "	2.620	.316	2.932	94.132
323	Extra C	Light brown	9 "	3.840	.432	3.690	92.036
324	"C"	Light brown	9 "	3.940	.612	7.092	88.356
325	Extra C	Light brown	9 "	2.600	.756	3.845	92.799
326	X	Dark brown	9 "	3.220	1.116	5.000	90.664
827	X	Dark brown	9 "	5.120	1.170	7.692	86.018

All the samples dissolved completely in water to a clear solution.

MAPLE SYRUP.

Three samples of maple syrup were examined: two of them were found to be pure, the third, which is manufactured in Chicago, and sold in this State in cans, contained thirty-five per cent of artificial glucose.

HONEY.

Three samples of honey were subjected to examination, two were found to be pure, while the third, labelled "white clover honey," contained fifty per cent of artificial glucose.

The presence of added glucose is indicated by the turbidity produced by oxalic acid in a solution of the honey in distilled water. This turbidity is due to the presence of gypsum in artificial glucose — a substance which is not contained in pure honey.

CONFECTIONERY.

Much of the candy now made is largely composed of glucose. Indeed some of it is nearly all glucose, as for instance "taffy," the cheaper gum drops, etc. The stick candies, although formerly made of cane sugar, have recently been adulterated with glucose in some cases to the amount of seven or eight per cent.

The coloring matter used in candies is often of a perfectly harmless

nature; but in other cases mineral colors are employed, some of them poisons, as chromate of lead, Prussian blue, etc.

Of ten samples of yellow candies examined seven contained chromate of lead. In another instance terra alba was found to the extent of from ten to fifteen per cent.

Some black cough drops contained a large amount of powdered charcoal added for medicinal effect.

Respectfully submitted,
W. H. PITT, M. D.

SUPPLEMENTARY REPORT ON SUGARS.

By ALBERT L. COLBY, Ph. B.

DR. C. F. CHANDLER,

Chairman of the Sanitary Committee:

I have the honor to submit the following report on Sugar, its adulterations, and the means used for their detection.

The adulterations and impurities of the commercial cane-sugars, were first thoroughly investigated by Hassall in 1855,* at the time of the food adulteration agitation in England. His investigations show conclusively that most of the brown sugars then in the market were unfit for use; that they contained many organic and mineral impurities, and were swarming with the sugar-mite. The white sugars were also found to be of an inferior character. The following list of adulterations and impurities were detected and reported to exist in sugars, by analysts of that time.

Organic impurities. Grape or starch sugar (glucose), potato and other starches, flour, dextrine, vegetable albumen, blood, fragments of sugar-cane, woody fibre, sporules and filaments of fungi, acarus sacchari or sugar-mite.

Inorganic impurities. Sand, particles of stone and grit, chalk (whiting), marble dust, pipe clay, terra alba, gypsum, plaster of Paris, bone-dust, lead, iron, lime, chloride of lime, common salt.

Recent investigations show that the sugars now in the market are free from the long list of insoluble mineral matter alleged to be used in former times, and that owing to the improvements in the processes of refining and purification, and the absence of raw sugars from the retail trade, most of the organic impurities previously detected are now absent, and the sugar-mite seldom seen.

Although the sugars of to-day are infinitely cleaner and practically free from foreign mineral substances, they are still subject to adulteration. The addition of starch or grape sugar (glucose) to the refined cane sugar, and the bleaching of the brown sugar by use of tin salts, are the falsifications now practiced in this important division of food.

In the present investigation 116 samples were examined. These were obtained principally from New York City as the short space of time allowed

*Arthur Hill Hassall, M.D.: Food and its Adulterations. London, 1855.

for the investigation rendered it impossible to collect samples representing the State. Care was however taken to secure the samples from different sections of the city and from all classes of stores.

The results of this examination may be briefly stated as follows:

1. *Insoluble foreign impurities.* Of the 116 samples of all kinds of refined sugars examined, 34 were classed as microscopically clean, 54 were very slightly contaminated with dust, 22 contained considerable dirt and 6 were very dirty. But in no case was there an intentional addition of insoluble mineral matters.

2. *Adulteration with glucose.* The 49 samples of white sugars examined were all found to be pure; but of the 67 brown sugars, 4 were adulterated to a large extent.

Grade of Sugar.	Number examined.	Pure.	Adulterated.
Cut loaf	7	7	....
Granulated	4	4	....
Powdered	33	33	....
"A"	5	5	....
Total white sugars	49	49	....
Light Brown "extra C"	49	46	3
Brown "C"	10	9	1
Dark Brown "X"	8	8	....
Total brown sugars	67	64	4
Total	116	112	4

This table gives a condensed record of the results of this examination. A detailed account of these results will now be given, using the classification just adopted.

I. *Insoluble foreign impurities.*

A review of recent examinations of sugar, shows, as has already been mentioned, that the sugars now in the market are free from the many alleged adulterations, such as sand, chalk, gypsum, pipe clay, terra alba, marble dust, etc.

The New York City Board of Health,* in 1871 reports the examination of sixty samples of sugar purchased at small city groceries, which were "found to be pure and unadulterated without exception." In 1881, the National Board of Health† reports the results of "an examination of 124 samples of all kinds of sugars; 57 were microscopically clean, 64 contained accidental dust, 3 were foul, and swarmed with the sugar mite."

In the present examination, a portion of the sample submitted was dissolved in water, to note the character of the solution and presence of

* First Annual Report Board of Health, N. Y. City, 1871, page 317.

† National Board of Health Bulletin, Supplement No. 6, January 1, 1881.

insoluble matters. The residues were examined with the aid of the microscope. The table gives the results of this examination.

Grade of Sugar.	Number examined.	Microscopically clean.	Slightly contaminated with dust.	Considerable dirt and dust.	Very dirty.	Solution in water.	
						Clear.	Cloudy.
Cut loaf.........	7	7	....	....	....	7	....
Granulated......	4	1	3	....	....	4	....
"A"...........	5	3	2	....	....	4	1
Powdered.......	33	8	19	6	....	20	13
Total white sugars	49	19	24	6	....	35	14
L't Brown, Ex. "C"	49	13	23	11	2	30	19
Brown, "C"....	10	1	5	2	2	4	6
D'k Brown, "X"..	8	1	2	3	2	....	8
Tot. brown sugars,	67	15	30	16	6	34	33
Total.........	116	34	54	22	6	69	47

This may be explained as follows:

1. *White sugars*. The *cut-loaf*, *granulated*, and "*A*" sugars now in the market are perfectly pure and clean.

Powdered sugar. Many exaggerated and false statements have been published, regarding the extensive adulteration of this variety of sugar Various powdered mineral substances, such as terra alba, chalk, marble dust, bone dust, gypsum, etc., are mentioned as largely used as adulterants. No proof of these assertions can be found, however, by direct investigation of the market.

In 1873, the New York city Board of Health * made an examination of 109 samples of powdered sugar purchased at small stores throughout the city, the results of which are as follows: "45 were perfectly clean and good, 51 were very slightly contaminated with dust, 8 contained considerable dust or dirt, and 5 were very dirty; but in no case was any adulteration whatever detected."

In the present investigation, 33 samples were examined with the following results. 8 were microscopically clean; 19 were very slightly contaminated with dust, and 6 contained considerable dirt or dust. None of the samples contained intentionally added mineral matters. The dust and dirt mentioned, as found in considerable quantities in six samples, was not added intentionally; but was due to the careless handling of the sugars in the small cheap groceries from which these samples were purchased. Of the 28 samples examined, 13 gave cloudy solutions in water. This was due to the accidental presence of a very small amount of starch or flour.

Ultramarine may be generally found in powdered sugar. It is used

*Third Annual Report Board of Health, N. Y. City, 1873, page 292.

to neutralize the yellow color of the sugar, and render it a bluish white. It is harmless and cannot be regarded as an adulterant, unless present in undue excess. It was noticed in 24 of the 33 samples examined.

It may be seen from these results, that powdered sugar is not largely adulterated, as is generally supposed. The presence of the powdered mineral substances alleged as used, could be so easily detected by any consumer, on simply dissolving the sugar in water, in which these are not soluble, that it is not likely that the dealers would adopt them as adulterants, especially when other means of sophistication, which can only be detected by chemical tests, are at hand.

2. *Brown sugars.* As may be seen from the table, 67 samples of the various grades of brown sugar were examined. Of these 6 were classified as very dirty, 16 as containing considerable dust or dirt, 30 as slighty contaminated with dust, and 15 as microscopically clean. Various accidental impurities, such as rice, canary-seed, tea-leaves, coffee, paper and sticks from the barrels, etc., were found in these sugars. A few were very dirty; but in no case was there proof of an intentional addition of insoluble mineral matters.

II. *Adulteration with Starch Sugar* (*Glucose*).

Although, as we have just seen, the sugars of to-day are free from insoluble mineral adulterations, the use of glucose as an adulterant is practiced to a considerable extent. The results of the examination of the 116 samples for the presence of artificial or added grape sugar or glucose, is given in the following table:

Grade of Sugar.	No. examined.	Unadulterated.	Adulterated with glucose.
Cut Loaf	7	7	....
Granulated	4	4	....
"A"	5	5	....
Powdered	33	33	....
Light brown, "extra C"	49	46	3
Brown, "C"	10	9	1
Dark brown, "X"	8	8	....
Total	116	112	4

This table shows that the white sugars are all unadulterated. But the brown sugar (especially the light brown coffee sugar "extra C") is the variety in which this sophistication is practiced. As the table shows, of the 67 samples examined, 4 were found adulterated, and to a large extent, as may be seen by the following analyses:

No. of sample.	Character of Sugar.	Per cent of added glucose.	Per cent of total glucose.
705	Brown "C."	22.20	undetermined.
706	Light Brown "extra C."	21.24	26.522
707	Light Brown "extra C."	29.79	32.834
708	Light Brown "extra C."	33.36	35.878

All colored sugars contain more or less "fruit" or "invert-sugar," which is a mixture of equal parts of dextro-glucose and lævo-glucose. This is produced from the cane sugar in the process of manufacture. The artificial glucose, used as an adulterant, is dextro-glucose made from starch.

These so called "mixed sugars," are sold in the wholesale market under certain trade names, such as "New Process Sugar," "Niagara A. B. C.," "Harlem B.," "Excelsior C.," etc., which signify to the purchaser their character. They are, however, usually disposed of in the retail trade as pure sugars. As most of these "mixed sugars" are sent to the country, they are rarely to be found in the hands of retail city grocers.

A review of other recent investigations of sugar proves the general use of glucose as an adulterant. From the six annual reports, on the adulteration of food in Canada,* the following tabular statement of results has been compiled.

Date of Report.	Number of sugars analyzed.	Genuine.	Adulterated with glucose.	Doubtful.
First Report 1876.........	15	12	3	....
Second Report 1877......	34	30	4	....
Third Report 1878	42	34	8	....
Fourth Report 1879	101	81	9	11
Fifth Report 1880.........	55	55		....
Sixth Report 1881........	63	63		....
Total..................	310	275	24	11

An investigation of 75 samples of sugar, made in 1879 by the Massachusetts State Board of Health, Lunacy and Charity,** shows the presence of an undue excess of glucose in 3 cases.

The recent investigation of sugars, made by Dr. Charles Smart, under the direction of the National Board of Health,† shows the very general use of glucose as an adulterant. "Among 47 brown sugars, most of which were furnished by dealers who knew that their samples would be examined, there were found 3 which contained glucose, while among 38 samples purchased for analysis, no less than 9 were thus adulterated. The glucose varied from a small admixture to 30 per cent."

The manufacture of starch sugar in the United States has sprung up entirely during the last ten years. It now ranks as an important and rapidly increasing branch of industry. The centers of the manufacture in this State are New York City and Buffalo.

In the trade, the solid products derived from the action of sulphuric acid on corn starch are known as, "Grape Sugar;" while the term "Glucose," is given to the thick syrups made from the same material. But chemically, the term "Glucose," applies to both solid and liquid forms. The varieties in the market are as follows:

1. *Glucoses.*

"Crystal H." containing about 40 per cent. glucose.

---

* Report on the adulteration of food, being supplement No. III. to the report of the department of Inland Revenue.
** First Annual Report State Board of Health, Lunacy and Charity of Mass., 1879, page 60.
† National Board of Health Bulletin Supplement, No. 6, January 1, 1881.

"Crystal B." containing about 45 per cent. glucose.
"Crystal A." containing about 50 per cent. glucose.

2. *Grape Sugars.*

"Brewers Grape," containing about 70–75 per cent. glucose.
"A." or "Solid Grape," containing about 75–80 per cent. glucose.
"Grained or Granulated Grape," containing about 80–85 per cent glucose.

"Anhydrous Grape Sugar* (100 per cent. glucose) a beautiful perfectly crystalline substance, has recently been made experimentally, and patents taken out for its commercial manufacture.†

The question as to whether or not commercial glucose exerts a deleterious effect on the system, has been the subject of much discussion among scientists, especially in Germany.

In 1878 Dr. Schmitz claimed to have proved by experiments on animals that the unfermentable substances in starch sugar were positively unwholesome, even poisonous. Prof. Nessler likewise became convinced of the injurious effect likely to result from the use of starch sugar and articles containing it. Dr. Von Mering of the University of Strasburg has repeated the experiments of Schmitz and Nessler, using in the last case the identical samples of sugar and wine which had been pronounced unwholesome. He also made experiments not only on cats and dogs, but on himself and others, and comes to a conclusion directly opposite to that reached by the authorities alluded to.

The various forms of starch sugar found in commerce under the names of grape sugar, glucose, maltine, etc., consist essentially of dextro-glucose with considerable quantities of dextrine and occasionally small quantities of other materials derived from the grain. The quality varies according to the material employed, which in some cases is comparatively pure starch, and in others the whole grain; and also according to the agents employed in converting the starch, which are either barley malt, or dilute sulphuric acid with possibly a very small percentage of other acids (hydrochloric and nitric). The proportion of glucose and dextrine depends upon the extent to which the conversion is carried. The first action of the malt or acid is to produce from the starch a mixture of glucose and dextrine. By further treatment the dextrine is gradually converted into glucose.

Provided the amount of acid, other than sulphuric, be exceedingly small, and perfectly pure carbonate of lime be used for the neutralization and removal of the sulphuric acid,** there is no reason to suppose that the commercial product contains any objectional substances, unless dextrine and glucose can be regarded as unwholesome. In as much as both these sustances are every-day constituents of human food, the glucose occurring in all our acid fruits, the dextrine found in every loaf of bread, and both produced by the action of saliva and other digestive fluids on all farinaceous food, there is no physiological objection to these substances.

Starch sugar, however, occupies certain physical and economic relations as compared with cane sugar, which cannot be overlooked.

---

*Journal of the American Chemical Society, Vol. IV, page 11.
† U. S. Patents, Arno Behr. Nos. 25,336, 250,334, 250,335, Dec. 6, 1881.
** It will be readily seen that the use of large amounts of hydrochloric or nitric acids, or an impure limestone (such as a magnesia limestone) would give rise to bitter salts which would remain in the glucose.

First. It has been estimated that starch sugar has a sweetening power two and one-half to three times less than that of cane sugar.

Second. Starch sugar sells in the wholesale market for about three and a half cents per pound, while cane sugar brings about eight cents.

Hence the mixing of this cheaper and less sweetening substance with cane sugar is not a question of a deleterious adulteration ; but one of fraud. The margin in the sugar market is usually so small, and this form of adulteration so profitable, that the temptation to the refiner and wholesale dealer may be readily seen.

But on the other hand the consumer, in purchasing a " mixed sugar " for a pure cane sugar, is not only defrauded in the *amount* of sweetening power properly present in the quantity purchased, but also pays much more for the sweetness *really* present than he would have done in purchasing a *less* amount of a pure cane sugar.

METHODS OF EXAMINATION.

I. *Determination of artificial grape or starch sugar in cane sugar.*

The method of hot polarization, devised by Drs. Chandler and Ricketts,* was adopted as a means of determining the amount of starch sugar, if any, added to the samples of commercial sugars examined. This method depends upon the following well-known facts :

1. *Dextrose*, under the conditions of analysis, exerts a constant effect upon the plane of polarized light at all temperatures under 100° C.

2. *Levulose.* The action of levulose is not constant, the amount of rotation to the left being diminished as the temperature is increased.**

3. *Invert sugar*, being a mixture of one-half dextrose and one-half levulose, does not affect the plane of polarized light at a certain temperture somewhere near 90° C.† (for it can easily be seen that the constant *dextro*-rotary power of dextrose must be neutralized by the varying *laevo*-rotary power of levulose at some such temperature. The exact temperature is determined by experiment).

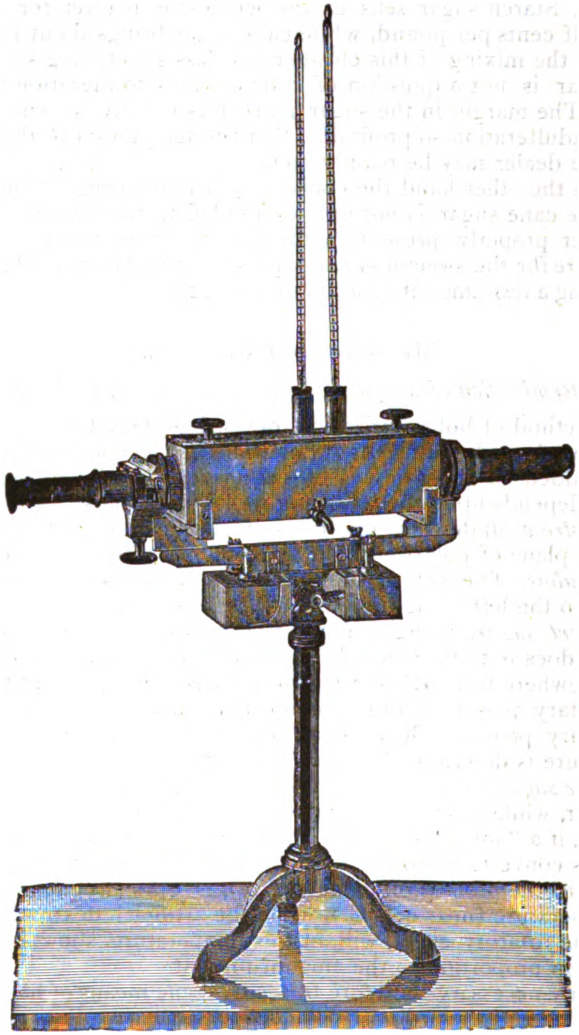
4. *Cane sugar*, when acted on by dilute acids, is converted into invert sugar, while dextrose is practically unaltered.

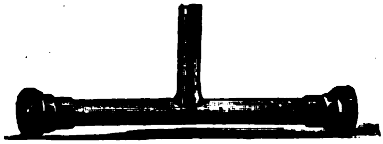
Hence, if a " mixed sugar " is heated with dilute acids, the cane sugar present is converted into invert sugar, which, with that originally present (due to the process of manufacture), is optically inactive at a certain temperature (near 90° C.), while the artificial dextrose, preservi g its specific rotatory effect, will, at this temperature, show a deviation to the right in proportion to the amount present.

It is only necessary therefore to secure some means of heating the observation tube of the ordinary polariscope, so that readings may be taken at any temperature under 100° C. The accompanying figure shows the arrangement adopted. The middle portion of a Soleil-Ventzke Saccharometer, ordinarily intended for the observation tube alone, is so modified as to admit of the interposition of a metallic water bath, provided at the ends with metal caps, which contain circular pieces of clear plate glass. The form of the tube, for holding the sugar solution to be

* Journal of the American Chemical Society, Vol. I, page 1.
** Watts' Dictionary of Chemistry, Vol. V, page 464.
† Watts' Dictionary of Chemistry, Vol. V, page 465.

polarized, is shown in the smaller figure. It is made of platinum and provided with a tubule for the insertion of a thermometer into the





sugar solution. The end metallic caps of the tube rest on projecting shelves inside the water bath, thus bringing the tube into the center of the bath, where it is completely surrounded by water. The cover of the water bath is arranged for the insertion of a thermometer, so that the

temperatures of the water bath and sugar solution may both be ascertained. The water bath is heated from below by two or four small spirit lamps, or gas burners. The first step in using the instrument is to determine, by experiment, the exact temperature of the water bath, or sugar solution itself, at which invert sugar is optically inactive on polarized light. This will vary slightly with different instruments. For the particular instrument and thermometer used in these analyses, 86° C. was found, by repeated experiment, to be the temperature of the pure inverted sugar solution at which the reading was *zero* on the sugar scale. The temperature of the water bath was not relied upon.

The next step was the determination of the value of a degree of the scale in terms of the glucose known to be the variety used to adulterate cane sugar. It was found that the rotation to the right at 86° C. was 41,° when using a solution containing in 100 c. c., fifteen grams of a sample containing 85.476° , chemically pure glucose. Hence as fifteen grams was the amount taken, $15 \times \frac{85.476}{100} \div 41 \times 100 = 31.2719$ grams, which is the amount of chemically pure glucose necessary to read one hundred divisions on the sugar scale of this instrument; or, each division =0.312719 grams chemically pure glucose. (A duplicate using 26.048 grams, gave as a factor 0.312488.)

Having determined the factor for a degree of the instrument, as above described, the accuracy of the method was tested by making mixtures of pure cane sugar, and known amounts of different grades of commercial grape sugar. The factor for each variety of grape sugar used, was first determined by experiment, and then from the reading of each sugar solution at 86° C., the amount of chemically pure glucose found was calculated.

The following is a tabular statement of the results:

Amount grape sugar added.	Per cent of C. P., glucose added.	Per cent of C. P., glucose found.	Difference.
1 gram in 26.048....	3.174	3.171	0.003
5 grams in 26.048·............	15.14	14.84	0.300
5 grams in 26.048..............	19.14	17.81	1.330

The success of the process greatly depends upon the care exercised in preparing the sugar solution for the polariscope. The inversion and subsequent clarification were accomplished as follows:

26.048 grams of the sugar to be examined were completely dissolved in about 75 c. c., cold water, and were treated with 3 c. c., of dilute sulphuric acid (1 to 5 by volume), on a water-bath at a temperature of about 70° C. for thirty minutes. The solution thus inverted, was then rapidly cooled, nearly neutralized with sodium carbonate solution (saturated), transferred to a 100 c. c. flask, and the gummy matters, etc., precipitated with 5 c. c., of solution of basic lead acetate.* The flask was then filled to the mark, the solution transferred to a small beaker, mixed with enough bone-black to clarify completely, and then thrown on a fluted filter. The amount of bone-black necessary depends on the grade of the sugar and consequent color of the solution. It was not

* Prepared by boiling for thirty minutes, 440 grams neutral lead acetate with 264 grams litharge, and one in one-half litres of water; diluting when cool to 2 litres and siphoning off the clear liquid.

found necessary to use, even with the lowest grade sugars, more than five grams.*

The clarified inverted sugar solution was then placed in the platinum tube of the saccharometer, the water bath filled with cold water, thermometers adjusted, and the temperature gradually raised by the spirit lamps to 86° C. This part of the operation should take about thirty minutes. If the sample was unadulterated, the polariscope reading would be zero at 86° C., while if starch sugar was present, the amount of deviation to the right in degrees and fractions, multiplied by the proper factor, and divided by the amount taken, would give the per cent. of chemically pure glucose added as an adulterant.

In previous investigations of sugars no attempt has been made to determine the amount of added glucose in adulterated samples. A determination of total glucose, by Fehling's method or otherwise, has been deemed sufficient. The amount of invert sugar naturally present being arbitrarily fixed at a certain limit for each grade of sugar examined, the sample is considered adulterated if the determination of glucose exceeds this figure. But the natural invert sugar varies in the same colored sugars within such wide limits, that this method would condemn, as slightly or somewhat adulterated, many pure sugars. The sugars made by the Scotch process for instance, in which no molasses is produced, run much higher in invert sugar than a sugar of the same color, made by a different process.

In doubtful cases the only safe method is a complete analysis of the sugar including determination of, water, ash, glucose, and cane sugar, which will add up over one hundred per cent. when the sample is adulterated, owing to the too high polarization of the cane sugar when mixed with dextrose.

II. *Determination of Total Glucose.*

This was done:

First. To obtain data for the calculation of the factors expressive of the value of a degree of the saccharometer for the different varieties of commercial grape sugar.

Second. To verify the results obtained by hot polarization of cane sugars.

After a careful comparison of various methods, the one finally selected, as affording the most concordant and reliable results was in the main that of Dr. Peter Collier, chemist to the Department of Agriculture.† The following is a description of the method:

1. *Reagents.*

Copper sulphate solution. Prepared by dissolving 69.28 grams c. p. copper sulphate, in 1 litre distilled water.

Alkaline tartrate solution. Prepared by dissolving 346 grams Rochelle salts (tartrate of soda and potash) and 80 grams caustic soda, in 1 litre distilled water.

* The bone-black used was pulverized to pass through 80 an mesh sieve, dried at 110° C. for 3 hours, and kept in a well corked bottle.

† Special report No. 33, Department of Agriculture; on Sorghum and Cornstalks, page 8-11. See also Tucker's Manual of Sugar Analysis, p. 205. Mohr; Lehrbuch der chem. anal. Titrirmethode. 5th ed., 1877. p. 447. Allen; Commercial Organic Analysis. Vol. II, p. 287.

Ammonia-ferric-alum solution. Prepared by dissolving 100 grams of the c. p. salt, with the addition of 50 c. c. concentrated sulphuric acid, in 500 c. c. distilled water.

Potassium permanganate solution. Prepared by dissolving about 3.2 grams of the salt in 1 litre distilled water, allowing to settle, and decanting off clear liquid. The value of the solution in terms of glucose, was obtained by titering against a solution of pure recrystallized oxalic acid corresponding to a known amount of metallic iron. Knowing that 1 c. c. of a solution of potassium permanganate containing 3.162 grams *pure* salt in a litre is equivalent to .0036 grams glucose,* all that was necessary was to calculate from these data the amount of pure salt in a litre of the solution prepared, and from this, by a simple proportion, the value of 1 c. c. in terms of glucose.

An example will make this clear: 40 c. c. of oxalic acid (equivalent to 112 mg. iron) required 20.325 c. c. potassium permanganate solution (average of three tests); hence, 1 c. c.=112÷20.325= 5.5104 mg. iron. By formula, 10 equivalents of iron are oxidized by 1 equivalent of potassium permanganate, hence:

(10 iron=560) : (1 potassium permanganate=316.2) :: 5.5104 : x.

X=3.1114 mg. pure potassium permanganate in 1 c. c. solution used, or 3.1114 grams in 1 litre.

Now as 1 c. c. of a solution of potassium permanganate, containing 3.162 grams pure salt in a litre, is known to be equivalent to .0036 grams glucose (see Mohr, reference given), we have the proportion;

3.162 : 3.1114 :: .0036 : .003542,

or 1 c. c. potassium permanganate solution is equivalent to .003542 grams glucose or invert sugar.

2. *Method of Conducting the Test.*

The total amount of glucose in the sample to be tested being approximately known — in the case of cane sugars, by the results of hot polarization and color of the sample, or in the case of starch sugars by the grade — a solution was made, of such strength as to contain about *one per cent* c. p. glucose. 25 c. c. of the copper sulphate solution, together with 25 c. c. of the alkaline tartrate solution were heated in a small beaker on a water bath to 75° –80° C.; 20 to 24 c. c. of the one per cent. sugar solution was added from a burette, the temperature again raised to 75° –80° C. (not above this) and the heating continued for 30 minutes. The beaker was then removed from the water bath, the suboxide of copper allowed to settle completely, and the blue supernatant liquid decanted into a second beaker, care being taken to carry over as little of the precipitate as possible. The liquor in the second beaker was then decanted into a third, and from thence passed through a small filter. The precipitate was then washed three times by decantation with about 75 c. c. boiling water, and the wash waters passed in order through the beakers and filter, care being taken to bring as little suboxide on the filter as possible. This amount of washing was found to be sufficient. The suboxide, on the filter and in the beakers, was then dissolved in about 20 c. c. of the acid solution of ammonia-ferric alum. This, diluted to about half a litre, was then titered with the potassium permanganate solution, as usual. The value of 1 c. c. in terms of glu-

*Friedrich Mohr Lehrbuch der Chemisch-Analytischen Titrirmethode, 1877, page 449.

cose being known, the calculation is made from the number of c.c. used in oxidizing the reduced iron present. The following table shows the results obtained by this method on various grades of cane sugar and starch sugar.

Sample of	Experiment No.	cc. Sugar solut'n used.	cc. Potass. perman. used.	Percent. of c. p. Glucose.	Remarks
Cane sugar No. 626.....	1	23	27.7	2.843	30 grms. of sample in
	2	23	27.7	2.843	200 c. c. water.
Cane sugar No. 666.....	1	23	32.8	3.367	30 grms. in 200 c. c.
	2	23	33.0	3.388	water.
Cane sugar No. 648	1	23	63.4	6.509	30 grms. in 200 c. c.
	2	23	63.65	6.534	water.
	3	23	64.5	6.622	water.
	4	23	64.2	6.591	water.
Cane sugar No. 672.....	1	23	68.7	10.579	20 grms. in 200 c. c.
	2	21	64.45	10.870	water.
Mixed sugar No. 706 ...	1	23	67.4	25.949	8 grms. in 200 c. c.
	2	21	62.9	26.522	water.
Mixed sugar No. 707....	1	20	53.8	32.855	2.9 grms. in 100 c. c.
	2	20	59.1	32.813	water.

Appended will be found classified references to the literature of sugar.

Respectfully submitted,

ALBERT L. COLBY, Ph. B.

SCHOOL OF MINES, COLUMBIA COLLEGE

BIBLIOGRAPHY.

I. JOURNALS.

The Sugar Cane. Manchester England. Monthly. Vol. 1–14. Aug. 2, 1869, to date (1882).
La Sucrerie Indigene. Compiègne, Oise, France. Now a weekly. Vol. 1–19. 1865 to date (1882).
Jahresbericht über die Untersuchungen und Fortschritte auf dem Gesammtgebiete der Zuckerfabrikation. Vol. 1–5. Breslau, Dr. C. Schiebler, Dr. K. Stammer; vol. 6–12, Breslau, Dr. K. Stammer; vol. 12–22, Braunschweig, Dr. K. Stammer. 1865 to date (1882).
Zeitschrift des Vereins fur die Rübenzuckerindustrie im Zollvereine. Berlin, vol. 1–14, 1851–1864.
Wochenschrift fur die Zuckerfabrikanten. Braunschweig, begun fall of 1875.
Berichte des Vereins der Ostböhmischen Zuckerfabrikanten. Prag, 1870–1871.
Zeitschrift fur Zuckerindustrie. Prag, Vol. 1, 1872, to ——.
La Sucrerie Belge. Paris.
Neue Zeitschrift für die Rübenzucker Industrie.

II. GENERAL WORKS AND ARTICLES.

Aubry le Comte, Ch. E. Législation et production du sucre de canne. 8vo. 1865.
Bonaparte, Napoleon Louis (Nap. III). Analyse de la question des sucres. 8vo. 1842.
Brown, Henry A. Analyses of the sugar question. Saxonville, Mass., 1879.
Dubrunfaut, A. P. Les sucres dans ses rapports avec la science, l' agriculture, l' industrie, le commerce, l'économie publique et administrative, etc. Tome 1, 8vo. 1873.
Fleischmann. Report on sugar. U. S. Patent office report, 1848.
Le Pelletier de Saint-Remy. Le Drawback du sucre indigène et la delaxe du sucre colonial. 8vo. 1863.
Molroguier. Examen de la question des sucres. 8vo. 1840.
Naquet, Alfred. Des Sucres. 8vo. 1863.
Ville. La Betterave et la législation des sucres. 8vo. 1868.
Rapperts du Jury International Exposition universelle de 1867. Vol. 8, 295 pp. Paris, 1868.
Rapports sur l' exposition universelle de 2878. L'industrie sucrière. Vol. 225, 13 plates.
Abridgments of specifications relating to sugar. A. D. 663-1866. Printed by order of Commissioners of Patents.

Watt's dictionary of chemistry and supplements. Article "sugar."

Containing numerous references to miscellaneous articles to Journals.

Ure's dictionary of arts, manufactures and mines. Vol. 2, pp 755–786; vol. 3, pp. 1019–1037.

Leopold Gemelin's handbook of chemistry. Vol. 15, pp. 237.

Containing numerous references to miscellaneous articles to Journals.

Muspratt's Chemistry. Vol. 2, pp. 965–1006.

Wagner's Chemical Technology. 1873, pp. 362–386.

Allen's Commercial Organic Analysis. Vol. 2, 1882, pp. 306–356.

III. WORKS ON CULTIVATION AND MANUFACTURE.

(Arranged chronologically into ten year divisions, and subdivided alphabetically according to authors.)

1820–30.

Dubrunfaut. Art de fabriquer le sucre de betteraves. 8vo., 559 pp., 6 plates. Paris, 1825.

Hibbert, R. Hints to the young Jamaica sugar planter. 12mo. London, 1825.

Roughby, T. Jamaica planter's guide, or a system for planting and managing a sugar establishment. 8vo. London, 1823.

1830–40.

Silliman, B. Manual on the cultivation of the cane and the fabrication and refinement of sugar. 8vo. Washington, 1833.

1840–50.

Blachette et Zorga. Nouveau Manuel complet de Fabricant et de Raffineur de sucre. 12mo., 491 pp. Manuet-Roret, Paris, 1841.

Delabarre, Adolphe, et Chaume, M. Améliorations chimique et mecaniques, apportées dans la fabrication et le raffinage du sucre de canne et de betteraves. 8vo. 1846.

Degrand, E. Fabrication et raffinage du sucre. 8vo. 1845.

Evans, W. J. The Sugar Planter's Manual. A treatise on the art of obtaining sugar from the sugar cane. 8vo., 244 pp. London, 1847.

Jeronnez, Achille. Traité analytique de la fabrication du sucre indigène, à l'usage des employés de l'administration des contributions indirectes. 8vo. 1843.

Leon, J. A. Sugar cultivation in Louisiana, Cuba, the British possessions, etc. 8vo. London, 1848.

Porter, G. R. Nature and properties of the sugar-cane. 8vo., 240 pp., 2nd ed. London, 1843.

Renouard, Felix. De la fabrication du sucre aux colonies françaises et des améliorations à ÿ apporter. 8vo. 1843.

Scoffern, John. The manufacture of sugar in the Colonies and at home. 8vo., 160 pp. London, 1849.

Whitehouse, W. F. Agricola's letters and essays on sugar farming in Jamaica. 8vo. London, 1845.

Wray, Leonard. The Practical Sugar Planter. 8vo., 412 pp. London, 1848.

Eight Practical Treatises on the Cultivation of the Sugar Cane; written in consequence of his excellency the Earl of Elgin's offer of a hundred pound prize. Jamaica, 1843.

1850–60.

Bessemer, Henry, C. E. On a new system of manufacturing sugar from the cane. 8vo., 60 pp. London, 1852.

Dailly. Distillation de la betterave. 8vo. 1855.

Dureau, B. De la fabrication du sucre de betterave dans ses rapports avec l'agriculture et l'alimentation publique. 8vo. 1858.

Hyde, J. F. C. Chinese sugar cane; its history, mode of culture, manufacture of sugar, etc. 12mo. Boston, 1857.

Kerr, T. Practical treatise on cultivation of the sugar cane and the manufacture of sugar. 12mo. London, 1851.

Olcott, H. S. Sorgho and imphee, the Chinese and African sugar canes; their origin, varieties, culture, etc. 6th ed., 12mo. New York, 1858.

Schmidt, Dr. Ch. H. Handbuch der Zuckerfabrication. 8vo., 531 pp., 12 plates. 4th Auf. Weimar, 1858.

Stanbury, Chas. F. The Chinese Sugar Cane and Sugar Making. N. Y. 1857.

Vanwormhoudt. Considérations sur l'extraction du sucre de la betterave. 8vo. 1855.

Wray, Leonard. Manuel pratique du planture de canne à sucre. 8vo. 1853.

1860–70.

Basset, N. Guide pratique du fabricant de sucre. Part 1, 8vo., 848 pp. Paris, 1861. Part 2, 8vo., 552 pp. Paris, 1865.

D'Abguy, Henry F. Q. The manufacture of beet sugar and alcohol and the cultivation of the sugar beet. Reports U. S. commissioners. 8vo., 90 p., 5 plates. Washington, 1869.

Goessmann. Notes on the manufacture of sugar in Cuba. Syracuse, 1865.

Grant, E. B. Beet Root Sugar and cultivation of Beet. 8vo., 108 pp. Boston, 1867.

Malavois. De la culture de la canne et de la fabrication du sucre, à l'île de la Réunion. 8vo. 1861.

Marchand, Eugene. Etudes sur la production agricole et la richesse saccharine des betteraves ensemencées à differentes epogues. 8vo. 1861.

Martin, S. Essay upon plantership. 12mo., 6th edition. Antiqua, 1867.

Nicoll, R. Essay on sugar refining and sugar. 8vo. Greenock, 1863.

Reed, W. The history of sugar and sugar yielding plants. 8vo., 204 pp. London, 1866.

Reynoso, Alvaro. Essai sur la culture de la canne à sucre. 8vo. 1865.

Schultz, C. G. Die Fabrikanten des Zuckers aus Rüben. Theorie und Praxis fur Practiker. 8vo., 6 parts. Berlin, 1862-5.

Stewart, F. L. Sorghum and its products. 8vo., 240 pp. Philadelphia, 1867.

Stohmann, Dr. F. and Siemens, Prof. C. Die Zuckerfabrikanten. 4to., 222 pp. Braunschweig, 1862.

Viollette, C. Dosage du sucre au moyen des liquers titrées, avec instruction pratique. 8vo. Paris, 1868.

Walkhoff, Lewis. Der Practische Rübenzucker-fabricant and Raffinadeur. 8vo., 900 pp., 3d ed. Braunschweig, 1867.

Zoega, F. S. Nouveau Manuel complet du Fabricant et du Raffineur de sucre. 12mo., 491 pp.

Manuels Rout Paris, 1868.

1870–80.

Basset, Nicholas. Guide pratique du fabricant de sucre. New edition, 3 vols. 8vo. 1872-5.

Benoit, J. A. Culture speculative de la betterave au point de vue de l'industrie sucrière. 12mo. 1874.

Blondel, J. Manuel de la fabrication du sucre de betteraves. 2d ed. 8vo. 1870.

Casalonga, D. Aux fabricants de sucre. 8vo. 1873.

Crookes, Wm. F. R. S. On the manufacture of beet root sugar in England and Ireland. 8vo., 290 pp. London, 1870.

de L'Escaille, J. Fabrication du sucre de betteraves. 8vo. 1870.

Gautier, Dr. L. De la Fabrication du sucre de betteraves. 8vo. 1874.

Goessmann, Chas. A., Ph. D. Report on sugar beets raised upon the farm of the Mass. agricultural college. (Reprinted from American Chemist.) 16mo., 35 pp. New York, 1872.

Lewis, F. Guide pratique des fabricants de sucre. 8vo., 152 pp. Lille, 1879.

Maumeme, E. J. Traité (théorique et pratique) de la fabrication de sucre. Vol. 1, 8vo. 648 pp. Paris, 1876. Vol. 2, 8 vo., 811 pp. Paris, 1878.

Possux, Louis. Guide du fabricant de sucre indigène. 8vo. 1873.

Siemens, Prof. C. and Grothe, Dr. H. Die Zukerfabrikation. 4 to., 259 pp. Braunschweig, 1871.

Stammer, Ch. Traité complet, théorique et pratique, de la fabrication du sucre. Guide du fabricant et du raffineur. 8vo. 1871. 2d edition edited with supplement, 1873.

Stammer, Dr. K. Lehrbuch der Zuckerfabrikation. 8vo., 888 pp., 14 plates. Braunschweig, 1874.

Walkhoff, Louis. Der Praktische Rübenzuckerfabrikant und Raffinadeur. 8vo. Part 1, 498 pp. Part 2, 453 pp. Braunschweig, 1872.

Walkhoff, Louis. Traité complet de fabrication et raffinage du sucre de betteraves. Original French edition. Translated from German by E. Merijot. 2 vols., 8vo. 1870.

Waroux, Louis. Traité élémentaire de la fabrication du sucre de betterave. 12mo. 1874.

1880–date (1882).

Fleury, Elie et Lemaire, Ernest. Manuel pratique de Diffusion. 8vo., 96 pp. Paris, 1880.

Gautier, Dr. L. Manuel pratique de la fabric.

Gautier, Dr. L. Manuel pratique de la fabrication et du raffinage de sucre de betteraves. 8vo., 207 pp. Paris, 1880.

McMurtrie, Wm. E. M., Ph. D. Report on the culture of the sugar beet and the manufacture of sugar therefrom. Dept. of Agriculture, Report No. 28. 8vo., 294 pp., 32 plates. Washington, 1880.

Stammer, Dr. K. Ergänzungsband zu dem Lehrbuch der Zuckerfabrikation. 8vo., 506 pp. Braunschweig, 1881.

IV. METHODS OF ANALYSIS.

(Arranged alphabetically according to Authors.)

Cammerson, Emile. Guide pour l'analyse des matiéres sucrées. 12mo., 76 pp. and plate. Paris, 1868.

Duboseq, J. Pratique du Saccharimeter Soleil modifiée. 8vo., 16 pp. and plate. Paris, 1869 ; 8vo., 24 pp. Paris, 1876.

Dubrunfaut, A. P. L'Osmose et ses applications industrielles, ou Methode d'analyse nouvelle, appliquée à l'epuration des sucres et des sirops. 8vo. 1873.

Frese, O. Beiträge zur Zuckerfabrication. Eine Sammlung der wichtigsten, beim Gebrauch des Aräometer and Polarisations Apparates, vorkommenden Tabellen. 8vo., 56 pp. Braunschweig, 1863.

Gunning, J. W. La Saccharometrie et l'impot sur le sucre. 8vo. 1875.

Landolt, H. Handbook of the Polariscope, translated by D. C. Robb and V. H. Veley. 8vo., 262 pp. London, 1882.

Madiner, Paul. Composition chimique et extraction du sucre de la canne de sorgho. 8vo. 1859.

Mandelbluh, Clement. Leitfaden zur Untersuchung der verschiedenen Zuckerarten. 8vo., 106 pp. Brünn, 1867.

Mohr. Lehrbuch der Chemisch-Analytischen Titrirmethode. 8vo., 5th ed. 1877. Page 443.

Moigno, L'abbe. Saccharometrie optique, chimique et melassimetrique. 8vo., 256 pp. Paris, 1869.

Monier, Emile. Guide pour l'essai et l'analyse des sucres. 16mo., 94 pp. Paris, 1867.

Pierre, J. I. Recherches analytiques sur la valeur comparée des principales variétiés de betteraves et sur la distribution des matiéres azotées dans les diverses parties de cette plante. 8vo. 1857.

Possoz, Louis. Notice sur la saccharometrie chimique. 8vo. 1874.

Terrell, M. A. Notions practiques sur l'analyse chimique des substances saccharifères. 8vo., 125 pp. Paris, 1875.

Tucker, J. H. Manual of sugar analysis. 8vo., 353 pp. New York, 1881.

Van Assche, Francois. Des Sucres, théorie moleculaire de leurs functions. 8vo., 102 pp. Paris, 1878.

Wild, H. Anleitung zum Gebrauch des Wild'schen Polaristrobometer. 8vo., 14 pp. Berne, 1868.

Report of investigation in relation to sugar and hydrometers. Bach and McCullough. Senate Doc. Washington, 1848.

Report of Analytical and other work done on Sorghum and Cornstalks. Peter Collier, Chem. Dept. of agriculture. 8vo., 101 pp., 14 plates. Dept. of agriculture, report No. 33. Washington, 1880.

V. NOTES ON ADULTERATIONS.

Allen. Commercial organic analysis, vol. 2. London, 1882. P. 322-324.

Hassell, Arthur Hill, M. D. Food and its adulterations. London, 1855. Pp. 12-31. London, 1876. Pp. 220-250.

Journal of the American Chemical Society, vol. 1, p. 1.

Canadian reports on the adulteration of food, being supplement No. III to the report of the dept. of Inland Revenue, Nos. 1-6. 1876-81.

First Annual Report of Board of Health of N. Y. City. 1871. p. 317.

Third Annual Report of Board of Health of N. Y. City. 1873. p. 292.

National Board of Health, Supplement No. 6. January 1, 1881. Report on adulteration of food.

First annual report State Board of Health, Charity and Lunacy. Mass., 1879. p. 60.

Reports of the Public Analysts on adulteration of food contained in.

Proceedings Society of Public Analysts, vol. 1. 1876.

The Analyst. Vol. 1-7. 1877 to date (1882).

Group VIII.

Wines, Beers, Spirits and Cordials.

By F. E. Engelhardt, Ph. D.

Prof. C. F. Chandler, Ph. D.,

Chairman of the Sanitary Committee of the State Board of Health:

Sir:—I have the honor to submit herewith the following report of my examinations of the group of foods assigned to me. It includes wines, beers, spirits and cordials; and although no samples of wine were submitted for examination, I have embodied in the report some general remarks on this division of the subject.

Very respectfully,

F. E. Engelhardt, Ph. D.

I. Wines.

By the term "wine" should be understood only pure grape juice, fermented and clarified.

Those preparations made from grape juice by other than the ordinary methods of procedure might be designated as "improved wines," to which could be added the name of the person originating the modification in manufacture.

Wines prepared artificially from raisins, cider, etc., with the addition of alcohol; coloring matter and other substances should be sold only as "artificial wines."

A good wine should be transparent; the color should not be too pale, and the taste and aroma should be pleasant. The sensation produced on the organ of taste, when drinking it, should not be for a moment, but lasting for some time, and the bouquet or aroma perceptible at once. When pouring it into a glass it should sparkle. A sour taste is always a sign of poor wine. If it quickly intoxicates we may suspect the addition of spirit, recognized by the more or less burning sensation in the throat, which is never produced by a good pure wine. Dizziness and headache are not produced by drinking pure wine. Cloudy, discolored, very highly colored wines are suspicious (Beyse's Kellerbüchlein).

Wines are generally divided into table wines, medium wines and dessert wines, but wine experts recognize "dry wines," "greasy wines" and "cordial wines," each having three divisions according to quality:

Red Wines of the First Class.

Dry Wines.	Greasy Wines.	Cordial Wines.
Chateau Lafitte, Chat. Margaux, Chat. LaTour, Chat. Haut Brion, etc.	Romanie, Conti, Rithebourg, Clos des Vougeat, Chambertin, Hermitage 1st quality, etc.	Lachrymae Christie. Cape Constantin, Messeree, Essence Chiras, etc.
Red Wines of the Second Class.		
Chat. Rosan, Chat. La Rose. Chat. Leoville, Juraneeon, Bouzy, Asmannshauser, Erlau, Adelsberg, Port wine.	Volnay, Vosne, Poinnard. Nuits, Beaune, Cote Rotie, Cahorse, Benicario, Cassis, Villany, etc.	Maocabeo, Rivisaltes Pouillour, Pedro Ximenes, Malaga, Tinto de Rota, Aleatico, Falerner.
Red Wines of the Third Class.		
Pouillat, St. Julien, Persat Mareuil, Affenthaler, Meiniker, Walporzheimer, Szegszarder, etc.	Comas, Marseille, St. George, Geory, Chassange.	The red Muscat wines of various countries, Picardan, Grenachen Minesher, etc.
White Wines of the First Class.		
Schloss Johannisberg, Leisten, Steinburg, Markobrunner, Greisenheim, Sillery, etc.	Hermitage, Sauterne, Barsac, Mont Rachet Ay, etc.	Commandery, Tokay` Riveaultz, Canarisect.
White Wines of the Second Class.		
Scharlachberger, Brauneberger, Steinwein, Raster, Xeres, (Sherry) Gumpolds Kirchner-Austich, Vino D'Oro, etc.	Straw wine of Wurzburg, Collmar St. Peray, St. Jean, Condrieux, Madeira, etc.	Malvoisier, Monte Fiascone, Alicante, Calabrese, Ruster Ausbruch, etc.
White Wines of the Third Class.		
Laubenheimer, Markgraefler. Forster, Klosterneuburger, Randeraiker Ressmilyer, Somlauer, Ankensteiner, Czernosecker, etc.	Landirac, Pyroles, Cervus, Langre, Cosmas, Blois wine, Teneriffe.	Linel, Piccardon, Marsalla, Maccabeo, Careavelho, Villanyi, St. George Ausbruch, etc.

(Partly taken from Beyse's Kellerbuchlein and Dr. Feuchtwanger's Fermented Liquors.)

Analysis of Wine.

The analysis of wine usually comprises the determinations of the specific gravity, alcohol, extract, sugar, acidity, ash, phosphoric acid and coloring matter in red wines.

Specific Gravity.— The specific gravity should always be determined by the aid of the specific gravity bottle at a temperature — if possible — of 60 deg. Fahrenheit.

Determination of Alcohol. —(a) *By distillation.*—Although alcohol may be determined in various ways, the distillation and indirect methods deserve the preference.

For distillation from 100 to 200 grams of wine are submitted to distillation in a retort or other suitable flask connected with a Liebig's condenser.* When from two-thirds to three-fourths of the quantity taken have come over, the distillation may be stopped, the distillate allowed to cool to 60 deg. F., its specific gravity taken, and from the tables the amount of absolute alcohol corresponding to the specific gravity can be ascertained. From the results thus obtained we can easily calculate the per cent for the wine submitted to distillation.

* To prevent foaming of the wine during distillation, add a little tannin, and to retain the volatile acids, a little caustic alkali before distillation to the contents of the retort.

(b) *By the indirect method.*—If we take a certain weight of an alcoholic liquid, containing other substances in solution and remove by heat (over a water-bath at about 75 deg. C.) the alcohol and then add distilled water to bring it up to the original quantity, we can ascertain the amount of alcohol according to the formala $D + 1{,}000 - D' = x$ in which D is the specific gravity of the original mixture and D′ the specific gravity of the mixture deprived of its alcohol. (Balling.) According to Thudichum and Dupré both methods with proper care give good results, but Dr. Elsner prefers the indirect method.

Determination of the Extract. — To determine the extract directly is not only most difficult, but it requires considerable time, hence it is best to adopt the indirect method of Balling just explained. Take a certain weight of the original wine (100 grams) evaporate it on the water-bath (at 75 deg. C.) to one-fourth, fill up to the same weight at 60 deg. F. and determine the specific gravity of the well mixed liquid, at about 59 deg. F. (15 deg. C.).

By reference to the accompanying table (I) the quantity of extract corresponding to any specific gravity can be ascertained. The figures of Schultze are better for wines rich in extract, but not so accurate for light wines as those of Hager. Instead of ascertaining the extract according to the table, we may ascertain the specific gravity of the evaporated, and again filled up wine, at 19 deg. F. to the fourth decimal, and multiply the two last places in the decimals by the number 2.25, the Houdart's factor (Elsner), which will give us the result at once.

TABLE I.

Giving the Specific Gravity and corresponding amount of Extract in 100 grams of Wine, according to Hager and Schultze.

Specific Gravity.	Extract in grams.		Specific Gravity.	Extract in grams.		Specific Gravity.	Extract in grams.		Specific Gravity.	Extract in grams.	
	Hager.	Schultze.		Hager.	Schultze.		Hager.	Schultze.		Hager.	Schultze.
1.0038	0.84	1.00	1.0063	1.39	1.64	1.0088	1.94	2.28	1.0113	2.48	2.92
1.0039	0.86	1.02	1.0064	1.42	1.67	1.0089	1.96	2.30	1.0114	2.50	2.94
1.0040	0.88	1.05	1.0065	1.44	1.69	1.0090	1.98	2.33	1.0115	2.52	2.97
1.0041	0.90	1.08	1.0066	1.46	1.72	1.0091	2.00	2.35	1.0116	2.54	2.99
1.0042	0.92	1.10	1.0067	1.48	1.74	1.0092	2.03	2.38	1.0117	2.57	3.02
1.0043	0.94	1.13	1.0068	1.50	1.77	1.0093	2.05	2.41	1.0118	2.59	3.05
1.0044	0.96	1.15	1.0069	1.52	1.79	1.0094	2.07	2.43	1.0119	2.61	3.07
1.0045	0.98	1.18	1.0070	1.55	1.82	1.0095	2.09	2.46	1.0120	2.64	3.10
1.0046	1.00	1.21	1.0071	1.57	1.84	1.0096	2.11	2.48	1.0121	2.66	3.12
1.0047	1.02	1.23	1.0072	1.59	1.87	1.0097	2.14	2.51	1.0122	2.68	3.15
1.0048	1.04	1.26	1.0073	1.61	1.90	1.0098	2.16	2.53	1.0123	2.70	3.17
1.0049	1.06	1.29	1.0074	1.64	1.92	1.0099	2.18	2.56	1.0124	2.72	3.20
1.0050	1.08	1.31	1.0075	1.66	1.95	1.0100	2.21	2.58	1.0125	2.75	3.23
1.0051	1.10	1.34	1.0076	1.68	1.97	1.0101	2.23	2.61	1.0126	2.77	3.25
1.0052	1.12	1.36	1.0077	1.70	2.00	1.0102	2.25	2.64	1.0127	2.79	3.28
1.0053	1.15	1.39	1.0078	1.72	2.02	1.0103	2.27	2.66	1.0128	2.82	3.30
1.0054	1.17	1.41	1.0079	1.75	2.05	1.0104	2.30	2.69	1.0129	2.84	3.33
1.0055	1.19	1.44	1.0080	1.77	2.07	1.0105	2.32	2.71	1.0130	2.86	3.35
1.0056	1.22	1.46	1.0081	1.79	2.10	1.0106	2.34	2.74	1.0131	2.88	3.38
1.0057	1.25	1.49	1.0082	1.82	2.12	1.0107	2.36	2.76	1.0132	2.90	3.41
1.0058	1.27	1.51	1.0083	1.84	2.15	1.0108	2.38	2.79	1.0133	2.92	3.43
1.0059	1.30	1.54	1.0084	1.86	2.17	1.0109	2.40	2.82	1.0134	2.94	3.46
1.0060	1.32	1.56	1.0085	1.88	2.20	1.0110	2.42	2.84	1.0135	2.96	3.48
1.0061	1.34	1.59	1.0086	1.90	2.23	1.0111	2.44	2.87	1.0136	2.98	3.51
1.0062	1.37	1.62	1.0087	1.92	2.25	1.0112	2.46	2.89	1.0137	3.00	3.54

The determination of sugar. Of the various methods that may be used for the determinations of sugar in wine, I prefer the method with Fehling's alkaline copper solution. Of light white wines I take 100 grams, and of those rich in extract 25 grams, remove the alcohol by heating over a water bath, and dilute the residue to 200 c. c. with distilled water. In the preliminary test I drop the diluted wine into the boiling copper solution (10 c. c. Fehling's to 40 c. c. distilled water) till the precipitate becomes bright red, and the blue color has entirely disappeared, filter off a few cubic centimeters, and test the latter both for copper and excess of precipitant. With a little practice very good results can be obtained by this method. I always make from two to three sugar determinations, and take the average. Colored wines must be previously decolorized with bone black, or acetate of lead solution, or both. If the presence of cane-sugar is suspected I take 100 c. c. of the diluted wine, heat it with a few c. c. conc. hydrochloric acid (C. P.) for about one hour, over a water bath at 75° C.; naturalize to alkaline re-action, fill up to 100 c. c. again, and test as before.

The optical method should be employed whenever an apparatus is at hand.

The determimation of the total acid. In 100 grams of wine I determine the acid volumetrically either with one-tenth normal soda solution, or lime-water, using red and blue Litmus paper to determine the neutral point.

The determination of sulphuric acid. This determination is of great importance at present in wine analysis, and should never be omitted, since not only — as is asserted — sulphuric acid is added directly to wine, but it may be present as the result of plastering and sulphuring, or by the addition of impure glucose, copperas, or alum, the latter to heighten the color of red wines. Of white wines I acidulate 100 grams with hydrochloric acid, heat to boiling, and precipitate with chloride of barium. For highly colored wines I take C. Weigel's method. Supersaturate 100 grams of wine with lime-water, dilute to 200 c. c. filter through a dry filter, and precipitate the sulphuric acid in 100 c. c. by chloride of barium, after acidulation with hydrochloric acid.

The determination of ash. I use 100 grams of wine, evaporate in a platinum capsule over a water bath to dryness, incinerate at a low tempature, and repeat heating till the weight is constant. Addition of a little nitrate of ammonia will accelerate the burning.

The determination of cream-tartar. 200 grams of wine are evaporated to syrupy consistency, allowed to cool, and then mixed thoroughly with 5 volumes of absolute alcohol, and allowed to stand for 24 hours. Wash the separated cream-tartar on to a filter with absolute alcohol, dissolve in warm water, and titre with normal soda solution.

The determination of glycerine. For this determination I take 100 grams of wine, discolorized if necessary, add a few grams caustic lime, and evaporate the mixture. The residue is treated with alcohol of 90 per cent. filtered and washed thoroughly with alcohol, again evaporated, and the residue extracted with a mixure of alcohol and ether (100 parts 90 per cent. alcohol and 150 parts ether) filtered, and the filtrate evaporated at a very low temperature at last under the air pump. The treatment with lime and the extraction with the alcohol-ether mixture should be repeated twice.

If the phosphoric acid has to be determined, I take the ash dissolve

in nitric acid, etc., employing the well known molybdate of ammonia process.

These determinations in connection with the behavior of the wine to polarized light, are usually sufficient to decide the question whether the wine is pure or an artificial product. Where there is a question as to whether the wine is made of cider or grape juice, the lime, magnesia, silica, sulphuric and phosphoric acids should be determined in the ash. The determination of succinic and malic acids and tannin are but rarely regarded. The presence of metals, like lead, copper, zinc, tin, etc., or of arsenic and antimony is rare in wines (excepting arsenic from sulphuring with impure sulphur, or coloring with fuchsin containing it). Where present they are usually due to some negligence or carelessness of the workmen in employing utensils and vessels not properly cleaned. Their recognition, together with that of iron and alumina, offers no difficulties if a sufficient amount of material is on hand.

The sulphuring of wines. Of the so called sulphuring — the burning of sulphur in wine casks, Wartha (Jahresb. der agricult. Chem. 1880, p. 607) says: "it should only be used for the purification of musty casks and the latter afterwards thoroughly washed with pure water. But not only is sulphur now burnt in half full casks, and new wines drawn into casks in which considerable sulphur has been previously burnt, but in some places producers go so far as to bleach the so called 'Schiller-wine' completely with sulphurous acid." He also states that often when wine is bottled, sulphur is burnt in each bottle previous to filling, whereby the so called "bottle ripeness" is produced much sooner. White wines drawn off into such bottles in 1852 contained many years afterwards a considerable quantity of sulphurous acid. It is obvious that such a beverage is injurious to health.

The substitution of acid sulphite (bisulphite) of lime in the sulphuring process, introduced some years ago, (and especially employed in the preservation of cider, etc.,) requires special attention, since it is asserted that animals fed therewith, suffered from intestinal catarrh (Koenig). The presence of sulphurous acid or sulphites is recognized by heating the wine till the alcohol is expelled, adding some pieces of pure zinc, and diluted sulphuric acid (C. P.) to the residue. The gas generated should be allowed to act on paper strips moistened with lead acetate or silver nitrate, which will become blackened, when these sulphur compounds are present.

Adulteration of wine. If wine is defined to be pure fermented and clarified grape juice without any addition, then the products obtained by the following so called improvements in wine manufacture, are not wine within the meaning of the term, and should not be recognized as such. They should be sold to the public under a name indicating their origin or their method of manufacture, as plastered and fortified wines, colored wines, wines made according to Chaptal's, Gall's, Petiot's or Scheele's methods, etc.

The "Plastering of wines." This consists in the addition of calcined plaster to the unpressed grapes, or to the expressed grape juice after fermentation has commenced. Objections; first, the formation of insoluble tartrate of lime, and soluble sulphate of potash, the latter having a bitter taste and acting as a purgative even in small doses. The French government prohibits the sale of wine having over 0.2 per cent. of

sulphate of potash. Second, the formation of acid sulphates and free sulphuric acid in wines.

Plastering of wines is practiced in Spain, Portugal and the south of France.

Fortifying wines. This consists in the addition of brandy, cologne spirit or French spirit to the wines, to increase their alcoholic strength and to stop further fermentation. Wines with more than 20 per cent of alcohol, are fortified. Especially practiced in southern Europe, Portugal, Spain, Italy, Greece, and France. Ports and sherries are almost invariably fortified.

The coloring of wine. The coloring of wine is practiced to a great extent and with various substances, either to heighten the color of a natural red wine deficient in color, or to make from white wines colored ones, or finally, to color artificial wines.

Among the substances that furnish the coloring matter for wine, the following are the most important: whortleberries, elderberries, pokeberries, privy-berries, cherries, red beets, alkana roots, black hollyhock and red poppy flowers, logwood, brazil wood, indigo fuchsin, cochineal, etc.

The identification of these various coloring matters in wine is a most difficult matter. Special investigations have been made by a number of chemists, and numerous methods proposed for the identification of these substances. Of these I shall give a few, but must refer for further information to the originals. In investigations of this kind, I deem it absolutely necessary, that the chemist has a sample of genuine wine, of the same kind as given him for investigation, that he make (personally), all the various color reactions with the genuine wine, and with wine samples colored with the various coloring matters, as given especially by A. Gautier* and Stierlin, etc., † because it is very difficult to describe the colors of the various precipitates, etc., correctly.

According to Filhol, if we add to the suspected wine ammonia till it smells distinctly, then some sulphide of ammonium, and filter, genuine wine gives a green filtrate, while artificially colored wines give a blue, red, violet, or brown filtrate.

Carpené gives the following very simple method, to decide whether a red wine is naturally, or artificially colored, which is highly recommended by Stierlin.

Take a piece of good white burnt lime, break it into two pieces, smooth the surfaces by a knife or file, and place a few drops in succession on the same spot of the smooth surface, and observe after a few minutes the color produced. Natural red wines give a yellowish brown spot; colored with fuchsin, a rose colored spot; colored with brazilwood, a rose colored spot; colored with logwood, a dark violet spot; colored with cochineal, a reddish violet spot; colored with black hollyhock, a yellowish brown spot; colored with poke-berries, a yellow somewhat red spot. Among the colors previously enumerated, fuchsin is the most objectionable, since it may contain arsenic, and even if pure, its repeated use is dangerous to health. The method of Fallier, improved by Prof. Ritter, gives according to Stierlin exact results, and is as follows: 200 c. c., of the red wine are evaporated about one-half, after

*Analyst 1876, No. 6, p. 109; No. 7, p. 150. Ueber Weinfälschung and Weinfärbung, Bern, 1877.

† V. Griessmayer im Chemisch. Centralblatt, 1877, P. 866 and 881.

cooling, put into a separating funnel (globe shaped with stopper), ammonia added till alkaline, and then thoroughly shaken; now we add pure ether and shake again. If the ether does not separate after a little while, add some more ether, etc., and wait till the liquids have perfectly separated; then let the lower liquid run out, wash the remaining ether twice with distilled water by thorough shaking, and separate the latter perfectly; transfer the ether into a beaker or small flask, attach to a Liebig's condenser, add a piece of pure white woolen knitting yarn, and evaporate the ether rapidly over a water bath. If the wine contains but traces of fuchsin the wool will be colored a rose tint.

The following method for separating fuchsin by F. König, seems to be of easy and quick execution. Pour 50 c. c. of the wine into a flask, add ammonia in slight excess till the red color is changed to a dirty green, into this mixture put about one-half gram of pure white knitting wool, and boil till all the alcohol and the ammonia are removed. The green color of the liquids during this operation gradually changes into a brownish red, and the greater quantity of the genuine wine color becomes destroyed, while the fuchsin and other anilin colors will fasten onto the wool; the latter is taken out of the liquid, washed with distilled water, and pressed out thoroughly, put into a test tube moistened thoroughly with caustic potash, (1 potash to 8 or 10 water), and under strong shaking gradually and carefully heated till all the wool has dissolved to a brown liquid; when cold, add one-half volume of pure alcohol, and pour on this mixture carefully, an equal volume of ether, shaking at first gently and afterwards strongly. In a few moments the ether, with some of the alcohol, collects over the brown lye; pour the ether into a test tube and add a drop of acetic acid, which will produce a red color if the least trace of fuchsin was present. Violet and blue anilin colors can be separated and recognized in a similar manner.

Improvement of wines. The method of Chaptal for improving wines, consists in the addition of sugar to the expressed grape juice before fermentation, to increase the alcoholic strength, and of marble dust, etc., to neutralize the excess of acid. The process was first recommended by the French minister Chaptal, in 1801. It is used especially in France in bad wine years, to produce the fine Burgundy wines; and it is said to be well adapted for fine bouquet wines, whose characteristic properties are not injured but rather improved thereby.

Dr. Gall's method consists in the preparation of a normal must with 0.5 to 0.6 per cent of free acid, and 22 to 24 per cent of sugar. If the must contains, for instance, from 1.0 to 1.2 per cent free acid, it is mixed with an equal quantity of water, and the necessary sugar added to bring it up to the required standard. Employed especially in Germany in bad wine years, and for unripe grapes.

The method of Petiot of improving wine and especially of increasing its quantity from 100 to 500 per cent dates from 1852. In the year Petiot produced from a certain quantity of grapes instead of 7,200 quarts no less than 34,200 quarts. First: by adding to the expressed juice an equal volume of sugar water, containing the same amount of sugar as the expressed juice. Second: to the remaining pulp of the grapes he added a new quantity of sugar water with eighteen per cent of sugar, and fermented it for three days. The latter experiment he repeated three times in succession with the same pulp, and sugar solutions, with from twenty-

two to twenty-three per cent of sugar, obtaining thus after fermentation as he says "wine in the full sense of the word."

These infusion wines resemble, according to Thudichum and Dupré "natural wines in all essential qualities ; they contain all the essential ingredients, and almost in the same proportions as the natural product." The value of Petiot's method to the wine producer, especially in unfavorable seasons, cannot be over estimated, since wine made after this method is ready for bottling in four months instead of two or three years as with the natural wines ; it requires little or no care, and almost no fining. These artificial wines are aromatic, retaining "the perfect bouquet of the natural ones." They are not subject to disease like the natural wines, and possess a most remarkable stability. In case the grapes contain an insufficient amount of acid for the several infusions, tartaric acid or cream tartar is added, and tannin for red wines ; also mallow flowers or whortleberries to the pulp before fermentation and alum to the wine to heighten the color. Infusion wines are produced in large quantities in Europe, especially in France.

Scheele's method, said to be practiced by wine dealers in England, Germany, and Austria, consists in the addition of from one to three per cent of glycerine to the wine, whereby the wine if young appears older, and has more body and stability.

To increase the stability of wine, salicylic acid has been introduced suceessfully within the last few years. How far these last two additions to wine may be injurious to health is an unsolved question as yet.

To what extent these various wine improving methods just enumerated are practiced on European wines exported to this country, and to what extent on our own native wines, I am unable to state.

Artificial Wines.

The manufacture of artificial wines from raisins, cider, sugar, alcohol, glycerine, tartaric acid, cream tartar, coloring matter, wine flavors, and water is no secret in Europe, nor in this country. Manufacturers of flavoring extracts, ethers and essences, usually give the necessary recipes with their wine flavors, of California, Catawba, Claret, Malaga, Madeira, Muscat, Port, Rhine, and Sherry. I might give a great many of these recipes but the following few may suffice : "Dissolve in a suitable vessel twenty-five pounds of grape sugar, and one-half pound of tartaric acid in twenty-five quarts of hot water, to which mixture add seventy-five quarts of cold water, and fifty pounds of grape pulp; stir well, cover, allow to ferment four or five days, stirring it occasionally, then press, and transfer to a barrel in the cellar and treat as other wine."

Port wine — Thirty gallons cider, (fermented) five gallons spirit, four gallons syrup, ¼ pound powdered gum kino, ¼ pound tartaric acid, six to eight ounces port wine flavor. To produce a better quality add either a few gallons German cherry juice, or any kind of pure wine, Spanish or Catalonic the best.

Another — Ten gallons hard cider, one gallon whortleberry-juice, two gallons elderberry juice, one pound essence of port wine, two gallons of sugar syrup, ten gallons pure spirit, ten gallons soft water.

Bordeaux or Claret wine — "To a decoction of one pound orris-root in five gallons of water, add one gallon of raspberry juice, ten gallons pure spirit, ½ pound essence of claret, one gallon sugar syrup and the coloring produced from cochineal."

Muscat wine — "Digest in ten gallons of white wine, fifteen pounds of large raisins, fifteen pounds currants, and add four gallons of white sugar syrup, and one dram of *oil of vitriol.* Let the whole mixture digest and ferment for some days, the clear liquor is then drawn off, and allowed to finish in the barrel till it is perfectly clear; then add one-half pound essence of port wine, one gallon of whortleberry juice, ten gallons of pure spirit and five gallons of water.

London Cherry — "Chopped raisins, 400 pounds, soft water, 100 gallons, sugar forty-five pounds, cream tartar one pound, cider, sixteen gallons, let the liquor remain in a closed vessel for one month stirring it frequently; then add of spirits eight gallons, wild cherries bruised eight pounds, let stand one month longer, and fine with isinglass."

LITERATURE OF WINES.

1. Annual reports of the inspector and assayer of liquors to the Commonwealth of Mass. Boston since 1876.
2. Babo: Von dem Weinbau. 1855.
3. Balling, C. J. N.: die Bereitung des Weines. Prag, 1865.
4. Bastide, Etienne: Vins sophistiqués. Bériers, 1876.
5. Batilliat: Traité sur les Vins de France. Paris, 1848.
6. Bersch, J.: Die Krandheiten des Weines. Wien, 1873.
7. Bersch, Josef.: Die Weinbereitung. Wien, 1871.
8. Bersch, Dr. J.: Die Vermehrung und Verbesserung des Weines. Wien, 1873.
9. Bersch, J.: Der Wein und sein Wesen. Wien, 1878.
10. Beyse J.: Kellerbüchlein des wohlerfahrenen Weinwirthes. Wien, Pest und Leipzig, 1874.
11. Blankenhorn, Dr.: Bibliotheca oenologia, etc. Heidelberg, 1875.
12. Blondeau, Charles: Letters sur la viticulture et la vinification. Paris, 1873.
13. Bresgen, H.: Der Handel mit verdorbenen Getränken, etc. Ahrweiler, 1876.
14. Brun, J.: Guide pratique pour reconnaitre et corriger les fraudes et maladies du vin. Paris, 1866.
15. Chaptal C.: Course d'Agriculture, Rossier.
16. Chaptal: Handbuch des Weinbaues. Weimar, 1840.
17. Chevallier: Wörterbuch der Verunreinigungen und Verfälschungen. Göttingen, 1856,
18. Dahlen, H. W.: Die Weinbereitung. Braunschweig, 1879.
19. Dochnahl, Fred Jac.: Die künstliche Weinbereitung, etc. Frankfurt, 1873.
20. Dochnahl und Rawald: Der Weinkeller, etc. Frankfurt, 1873.
21. Dubief, L. F.: Guide pratique de la fabrication de vins. 1878.
22. Elsner, Dr. Fritz.: Die Praxis des Nahrungsmitted-chemikers. Leipzig, 1880.
23. Feltz V. et E. Ritter: Etude experimentale de l'action de la fuchsine l'organisme. Nancy, 1877.
24. Feuchtwanger, Dr. Lewis.: Fermented liquors, 5 edition. New York, 1867.
25. Flügge Dr. C.: Lehrbuch der Hygienischen Untersuchungsmethoden. Leipzig, 1881.

26. Foellix, J.: Gründliche Belehrung über richtiges Gallisiren oder Veredeln des Traubenmost in nicht guten Weinjahren durch Zucker und Wasserzusatz. Mainz, 1870.
27. Gall, Dr. L.: Das Gallisiren. Trier, 1867.
28. Gall, Dr. L.: Practische Anweisung sehr gute Mittelweine aus unreifen Trauben zu erzeugen. Trier, 1854.
29. Gall, Dr. L.: Die vortheilhaftesten Methoden der Weinbereitung. Trier, 1854.
30. Gautier, A.: La sophistication des vins, etc. Paris, 1877.
31. Goppelsroeder, Dr. Fred: Sur l'analyse des vins, etc., Mulhouse, 1877.
32. Grandeau, L. Dr.: Handbuch für Agricultur-chemische Analysen. Berlin, 1880.
33. Gut, J.: Mostbüchlein, dritte. Auflage, Bern.
34. Hager, H.: Untersuchungen. Leipzig, 1871.
35. Hamm, W.: Das Weinbuch. Leipzig, 1874.
36. Henderson: Geschichte des Weines.
37. Haraszthy: A., Grape culture, Wines and Wine-making. New York, 1862.
38. Hellenthal's, K. A.: Hilfsbuch für Weinbesitzer und Händler, neunte Auflage von J. Beyser. Wien, 1873.
39. Husson, L.: Du vin, ses propriétés, sa composition, etc. Paris, 1877.
40. Kohler, J. M.: Neueste Fortschritte in der Weinbereitung. Aarau, 1871.
41. Kohler, J. M.: Der Weinstock und der Wein. Aarau, 1869.
42. König, Dr. J.: Die Menschlichen Nahrungs- und Genussmittel. Berlin, 1880.
43. Ladray, C.: L'art defaire le vin. Paris, 1865.
44. Ladray, C.: Traité de Viticulture et d'oenologie. Paris, 1873.
45. Leuchs: Weinkunde. 1839.
46. Martin, L.: De, sur la fabrication des vins a L'abri du contact de l'air. Montpellier, 1867.
47. Maumené, E. J.: Traité théoretique et pratique du travail de vins. Paris, 1872.
48. Maumené, E. J.: travail de vins. Paris, 1873.
49. Mayer, V.: Die Ausbrüche Secte und Südvine, nebst einem Anhange enthaltend die Bereitung der Strohweine, Rosinen, Hefe, Kunst und Obstweine. Wien, Pest und Leipzig.
50. Meyer und Finkelnburg: Gesetze betreffend den Verkehr mit Nahrungsmitteln, Genussmitteln, etc. Berlin, 1880.
51. Mohr, F.: der Weinbau und die Weinbereitungsmethode. Braunschweig, 1865.
52. Mulder: Chemie des Weines. Leipzig.
53. Nessler: Der Wein, etc. Stuttgart, 1878.
54. Nessler, J.: Die Behandlung des Weines. Dritte Auflage. Stuttgart, 1878.
55. Nessler, C.: Im amtlichen Bericht uber die Wiener Weltaustellung. Braunschweig, 1874.
56. Neubauer, C.: Chemie des Weines. Wiesbaden, 1870.
57. Nowak, Dr. Josef: Lehrbuch der Hygiene. Wien, 1881.
58. Pasteur, M. L.: Etudes sur le vin.
59. Pasteur, M. L.: Die Alcohol Gährung, deutsch von Griesmayer. Augsburg, 1871.

60. Pohl, J. J.: Chemisch technische Untersuchungen Oestereichischer Weine. Wien, 1864.

61. Pohl, J. J.: Behelfe zum Gallisiren der Weine. Wien, 1863.

62. Prescott, A. B.: Chemical examination of Alcoholic Liquors. New York, 1875.

63. Quarizius, C. G.: Chemish Künstliche Bereitung der Moussirenden, Weine, etc. Weimar, 1861.

64. Reitlëitner, C.: Die Analyse des Weines. Wien, 1877.

65. Ritter, E.: Des vins colorés par la Fuchsine. Paris, 1876.

66. Robinet fils: Mannual pratique et élémentaire d'analyse chimique de vins. 1866, Paris.

67. Robinet, E.: Mannual pratique d'analyses des vins, fermentation alcoolisation, falsification. 3me edition, 1879, Paris.

68. Roth, Emil: Die Chemise des Rothweines. Heidleberg, 1878.

69. Roth, E.: Die Weinbereitung und Weinchemie. Heidelberg, 1878.

70. Sonnenschein, F. L.: Handbuch der Gerichtlichen Chemie, Berlin, 1869.

71. Stahlschmidt, Dr. Carl: Bolley's Handbuch der technisch chemischen Untersuchungen. Leipzig, 1879.

72. Steirlin, Dr. R.: Ueber Weinfälschung und Weinfärbung mit besonderer Rücksicht auf das Fushsin. Bern, 1877.

73. Thein, J.: Die Weinveredelung und Kunstfabrication, etc. Prag, 1873.

74. Thiel, Dr. C. E.: Nahrungs und Genussmittel, etc. Braunschweig, 1874.

75. Thudichun and Dupré: A treatise on the origin, nature and varieties of wine. London and New York, 1872.

76. Weigert, Dr. Leop.: Beiträge zur Klärung und Conservirung des Weines. Wien, 1878.

II. Liquors.

Liquors are sugar solutions fermented and then distilled, hence they are also called distilled spirits.

Liquors may be divided into the following three classes:

1. Simple liquors.
2. Compound liquors or double spirits.
3. Cordials, or liqueurs.

To the latter class we may add the so called bitters, essences, elixirs, crêmes, ratafias, punch essences, etc.

Simple liquors are, as already stated, fermented and subsequently distilled and rectified, sugar solutions. Hence their main constituents are water and alcohol, with small quantities of volatile substances usually formed during the process of fermentation of the sugar solution; as fusel oils, volatile acids, alcohols, ethers, aldehyde, etc., Tannin and coloring matters, when found in these liquors should only be due to the wood of the casks containing them.

The sources of liquors are many fold, thus we may prepare them:

First: From liquids containing alcohol (previously formed by fermentation), by distillation and rectification; cognac brandy from wines, cider brandy from fermented cider, etc.

Second: From liquids or solids containing sugar; by fermentation, distillation, and rectification. From the juice of beets, carrots, sugar-cane, cherries and prunes; from molasses of cane and beet sugar manufacture; from the marc of grapes, and residues of wine manufacture; from whey, etc.

Third: From substances which contain neither alcohol nor sugar, but the constituents of which may be converted into sugar and dextrose, as potatoes, rye, oats, barley, wheat, rice, buckwheat, etc.

Among the simple liquors the most important ones are cognac brandy, whiskey and rum.

COGNAC BRANDY.

Cognac brandy in the proper acceptation of the word, and thus it should be defined by law, is the distilled spirits of wine, containing therefore only the volatile constituents of wine, a little coloring matter from the cask and a trace of tannin from the same source. It is mainly produced in the south of Europe and especially in France in the district of Deux Charentes. Its name comes from the town of Cognac in the above district. From seven to twelve gallons of wine yield only one gallon of brandy—"eau de vie supérieure" as it is called in France. In regard to the color of brandy, a late writer in the Science Monthly states: "Cognac brandy is at first a colorless liquid, but it gradually acquires a pale yellow or amber color from the cask in which it is kept for aging. It never appears with its natural color however, public taste having become vitiated to the extent of requiring a rich brown or brandy color, which is imparted by a mixture of caramel or burnt sugar. Occasionally, too, a little red sanders wood (Ptero carpus santalinus) is used for coloring." The alcoholic strength of French Cognac brandy varies from about forty-eight to sixty per cent by volume, but is usually about fifty-five per cent. The quality of brandy, and consequently its price (and this is true of all other liquors), does not depend on the alcoholic strength of the liquor, but on its bouquet (aroma), and its taste, both of which are greatly improved by age. The various "brands" are produced by the large commission merchants, by mixing, or blending as it is often called, the different varieties of spirit, purchased from the distillers.

The so-called "eau de vie de marc," an inferior brandy, is partly produced from the dark red wines of Spain, Portugal, etc., and partly from the mancs or refuse of grapes, the scrapings of wine casks, and the so-called lees, deposited from wine by keeping. This Cognac usually contains some fusel oil, derived from the skins of the grapes, to which is due its more fiery taste as compared with the genuine Cognac brandy.

Although I have carefully examined the chemical journals and books at my command, I have found only a few analyses of brandy, which give the alcoholic strength, the specific gravity of the liquor, its extract and ash.

Analyst.	Specif. Gravity.	Vol. per cent. alcohol.	Weight per cent.	Extract per cent.	Ash per cent.
Dr. J. König *	0.8987	69.5	61.7	0.645	0.009
H. Grouven *	0.8987	55.0	47.3	0.645	0.009

* Nahrungs und Genussmitted. Erster Theil, page 187; and Zweiter Theil, page 469.

Prof. J. F. Babcock* from 35 to 57.5 per cent by volume; lowest and highest percentage in eighty-one determinations.

METHODS OF ANALYSIS.

In the analysis of ordinary liquors, like cognac, rum, whisky, or gin, the main quantitative determinations are the specific gravity, the alcohol, the solid residue, and the ash. These determinations offer no difficulties. The *specific gravity* may be determined either by the pyknometer as described under wine, or with a good specific gravity hydrometer at a temperature of 60° F. The *alcohol* determination can be made in a number of ways, as stated under wine, though I prefer the distillation method as described there.

Since the liquors mentioned above are usually sold by measure, and according to the indications of the United States custom house hydrometer, and since, moreover, the government collects its revenue according to its indications, I deem it but proper that the alcoholic strength of these liquors should be stated as found by that instrument.

For the *solid residue* a small quantity, about 50 grams or c. c., should be evaporated over the water bath to dryness in a platinum capsula, till a constant weight is obtained. By incinerating the residue the ash is obtained. The latter may be dissolved in acid, etc., and serve for determining the presence of metals, as copper, lead, etc.

The *acidity* of pure liquors is usually due to a little acetic acid, and it has been asserted that all genuine cognacs or brandies are acid. The quantity may be determined, if no other acid is present, as described under wine, with 1-10 normal alkali. Tannic acid, derived from the casks, is recognized by giving precipitates with metallic salts, gelatine, etc. Quantitatively it may be determined in several ways, but, preferably Wagner's method, as improved by J. T. Clark. (Am. Chemist, Aug. 1876, p. 44.)

Fusel Oils.— The presence of fusel oil is best ascertained by placing in a small white porcelain dish, 10 c. c. of the suspected liquor, previously decolorized by bone black (properly purified and reburnt). Now drop into the liquor about 5 drops of the officinal hydrochloric acid c. p., and then about the same number of drops of freshly distilled, and perfectly colorless oil of anilin. If only a minute trace of fusel oil is present, the drops of the anilin, as they sink to the bottom of the dish, will soon become slightly tinged with a rose color. The intensity of the color increases with the quantity of fusel oil present. Of all the tests for fusel oil with which I am acquainted this is the most sensitive one, and it will indicate the presence of fusel oil when all others seem to fail. The best known and the most ready method to apply, is testing for fusel oil by the smell, either by rubbing the suspected liquor between the palms of the hands, and to smell as soon as the alcohol is evaporated

---

* Prof. James F. Babcock, in his first and second annual report as State Inspector and assayer of liquors to the Commonwealth of Massachusetts, Boston 1876 and 1877.

M. U. Green, Ph. D. (American Chemist, volume VII, No. 2, page 46), found "pure grape brandy" wholesale price $6 per gallon, dark amber color, neutral reaction, pleasant but sweetish taste, and odor of the grape. Alcohol 43.8 p. c. by weight; fusel oil, a trace; color of oak; oil of wine; solid residue, .042, p. c. saccharine, with traces of potassium and sodium acetates."

"French brandy," sold at eighty cents per pint, dark amber color, acid reaction, odor and taste of plain grain spirit. Alcohol 45 4 p. c., by weight, fusel oil very slight trace; acetic acid 0.002 p. c.; tannin a trace; solid residue 0.005 p. c."

"Apple Brandy." Alcohol 44, 4 p. c. by weight; acetic acid 0.002 p. c.; potassium and sodium chlorides, a trace; capsicow appreciable in the residue; solid residue very slight; no tannic acid.

from the hands, or by pouring the liquor into a glass and then returning it to the vessel; as soon as the alcohol has evaporated from the bottom and sides of the glass, the smell of fusel oil, when present even in very small quantities (1-10 of a per cent.) can be easily detected by an expert. For the quantitative determination of fusel oil I must refer to Trescott's "Chemical Examinations of Alcoholic Liquors."* My opinion is, that if liquors contain fusel oil to the extent that it is readily perceptible by its odor, such liquor is a suspicious article, although it may be genuine; and it should not be sold as a beverage until it has undergone a new rectification through a charcoal filter.

When fermented saccharine liquids are submitted to a distillation, we obtain, as previously stated, besides water and alcohol (common or ethyl alcohol), small quantities of other alcohols and volatile fatty acids, which constitute what is usually known as fusel oil. All raw material used for the preparation of a distilled liquor has its own peculiar fusel oil. Hence we have a potato fusel oil, a sugar beet fusel oil, a rye fusel oil, a corn fusel oil, a grape fusel oil, etc., which contain in various proportions propyl, butyl, amyl alcohol, etc., and the corresponding acids, propylic, butyric, valerianic acids, etc. During the ageing of the liquors, the constituents of the fusel oils gradually act upon each other, producing new combinations, known as ethers, which impart to the liquors their peculiar bouquet or aroma, as acetic ether, butyric ether (pineapple essence), œnanthic ether (Hungarian wine oil), pelargonic ether (finest cognac oil), acetate of amyl (pear oil), valerianate of amyl (apple oil), etc. Hence the greater the age of a distilled liquor, the more of the constituents of the fusel oil disappear, and the finer becomes the aroma of the liquor in consequence of the formation of these ethers.

Fusel oil is a poison, and the most poisonous constituent in it is the so called amyl alcohol (especially large in the fusel oil of potatoes). Dajardin (see Chemisches Centralblatt fur 1880, p. 172) arranges the genuine liquors in the following order, according to their poisonous qualities, commencing with the least injurious.

1. Cognac from wine (containing only traces. if any, of amyl alcohol).
2. Cognac from perry.
3. Cognac from cider and wine tresters.
4. Whisky from sugar beets.
5. Whiskies from the various grains.
6. Whisky from sugar beet molasses.
7. Whisky from potatoes.

"Rabuteau deduced from experiments with frogs (L, Union 1870, 90; Schmidt's Jahrbuecher der Gesamt. Medicin. B. 149, p. 264) that amylic alcohol produces poisonous effects closely resembling those of ethylic alcohol, but of fifteen times greater intensity. The frogs were floated in a 0.002 solution of the alcohol (1 part to 500 parts of water), and then in stronger solutions, and the effects of depressed action of the heart, congestion, anaesthesia and death were timed. Amylic alcohol produced the same effects in the same times as did ethylic alcohol of fifteen times greater concentration, or butylic alcohol of three times greater concentration. From which it is inferred that, the poisonous action of butylic alcohol is five times more intense than that of ethylic

*See also: "Wieder die Nahrungsfälscher. Organ des Untersuchungamtes für Lebensmittel, etc., Hannover. Heft. 12, 1881, p. 184.

alcohol in the same quantity. Rabuteau also experimented with himself by taking 0.25 to 0.50 grams (4 to 8 grains of amyl alcohol) in a glass of wine, and the results confirmed the conclusions given above."

"On the other hand, observers of cases of delirium tremens and acute alcoholism, have not found it more likely to result from the use of cheap grades of spirits with much fusel-oil, than from the purer and stronger grades." (Alcoholism in Russia, Hermann. Prescott "Chemical Examination, etc.," page 18.)

From the facts and statements just quoted it is evident that the worst and most injurious ingredient in our so-called strong or distilled liquors is the alcohol itself, and next come the fusel-oils. These latter we can remove almost entirely by a proper rectification, and the law should require their removal as far as possible from all liquors, * while the quantity of the alcohol should also be regulated by law, since from numerous investigations, including my own, it is evident that the amount of absolute alcohol in 100 per volume, varies in the various simple liquors from 60 per cent to almost 25 per cent, the lower, the better for the health of the consumer.

Coloring and astringent matters, due to the oaken casks in which liquors are kept, are generally found in such very small quantities in genuine liquors that we can usually neglect their determination, beyond proving their presence in the solid residue, as previously indicated. The same, is true of the determination of tannic acid. Attention has been already called to the fact that genuine brandies are colored artificially with caromel and red sanders wood.

Artificial Brandies and Adulteration of Brandy.

Dr. Edward Smith of England (in Foods, 1873), says: "Brandy is or should be the choicest and most agreeable member of the class of ardent spirits. It should be prepared by distillation from wine. * * * A very large proportion of the brandy consumed all over the world is, however, made with little or no wine, and is simply alcohol distilled as in the preparation of whiskey, and colored and flavored with oil of cognac. A very large quantity of common fiery potato spirit is sent to France from Germany to be redistilled, and forwarded to us as French brandy, whilst various qualities of spirits are made in this country into British brandy."

"Brandy is as colorless on distillation from wine as alcohol distilled from malt, and can readily be colored by adding burnt sugar. Its flavor is due to volatile oils and œnanthic ethers, the nature of which has not been determined, but some are derived from the distillate, and others are produced in the process of distillation, and by age."

"It is therefore evident that brandy differs from whisky and other moderately good spirits only in the flavors which it possesses, and the inferior kinds are in no degree superior to them. Perhaps there is no preparation used as food or medicine in which there is so great a variation in quality, whilst at the same time the changes are due to subtile substances, but little known to the wisest, and inappreciable by the unrefined and untutored taste"—(pages 381 and 382).

Prof. James F. Babcock says, on page 9 of his First Annual Report

* The Congress at Paris against Alcoholism decided that, fusel oils in liquors should be considered as injurious, and that the sale of liquors containing these substances should be prohibited.

as Inspector and Assayer of Liquors: "Much of the brandy imported into this country is, according to good authorities, prepared from corn spirit, flavored to imitate brandy and colored by means of burnt sugar. It is said that corn spirit is largely imported into France to be used in the adulteration of French brandy."

"What is known as British brandy consists for the most part of corn spirit flavored. The flavor is accomplished by the addition of a little genuine brandy, but more frequently, according to Dr. Hassal of London, 'by distillation of the marc, the name given to the refuse skins and pips of the grape left after the distillation of the wine.'"

"By distilling British molasses over these lees, says another authority, 'the manufacturer obtains, to some extent, the peculiar flavor which characterizes French brandy.'"

Professor Babcock in his Second Annual Report (page 15), says: "Almost all whiskies, brandies and "old" rums are artificially colored by the addition of caramel or burnt sugar. This custom has become so general that it can scarcely be called an adulteration; the caramel is harmless and is used only in small quantities."

"Brandy is chiefly adulterated by the addition of water or spirit, or is produced artificially by the use of oil of cognac, an essential oil derived from the lees of wine, and to which in part brandy owes its bouquet."

Muspratt (New Encyclopædia of Chemistry, p. 67), says: "British brandy, British gin, whisky or rum are produced from corn; French brandy, from wine; West India rum from sugar or molasses." The same author says (p. 111): "The brandy sold in England is, for the most part artificial — the fabrication of the rectifying distiller."

The following recipe for artificial brandy is given by Dr. Ure: "Dilute the pure alcohol to proof pitch, and add to every hundred pounds weight of it from half a pound to a pound of argol — crude wine stone — dissolved in water, some bruised French plums, and a quart of cognac. Distil this mixture over a gentle fire in an alembic provided with an agitator. The addition of brandy and argol introduces œnanthic ether, and if a little acetic ether be added to the distillate, the whole imparts the peculiar taste of genuine cognac brandy; color with burnt sugar if necessary, and add a little tannic acid to impart astringency. 'This brandy' he says, 'may be reckoned as wholesome as alcohol in any form can ever be.'"

Prof. Parrish thinks "we might make brandy for ourselves, as there is no merit in having it imported. We should set about substituting the variable uncertain adulterated brandy of commerce by a definite liquor of the same alcoholic strength as the standard specimens."

In 1875, Prof. Albert Prescott stated that "artificial brandy is a grain spirit, with addition of substances which are characteristic constituents of a grape spirit. It may be made more or less nearly identical in composition with veritable brandy. Fictitious brandy is a grain spirit with additions which make it resemble a grape spirit in flavor and odor, rather than in composition. A substitution for brandy is a grain spirit (in most cases), not modified to approximate grape spirit, but merely presented as such. The term, brandy, as used in commerce without qualification, must be held by common consent to include artificial brandy. ('Chemical examination of alcoholic liquors,' page 21.) On page 23 he quotes the following formulas for the manufacture of brandy, etc.: 'Brandy essence'—15 parts of acetic ether, 12 parts of spirit of

nitrous ether, 1 part of rectified woodspirit. 'Brandy essence'—5 parts of oil of grapes, 4 parts of acetic ether, 1 part of tincture of allspice, 3 parts of tincture of galls, 100 parts of 'alcohol.' Take 1 part of either of these 'brandy essences,' to 1,000 parts of 'alcohol,' with 600 parts of water; or, 2,500 to 3,000 parts of 80 to 90 per cent alcohol, 1,700 to 2,000 parts of water, 10 parts of spirit of nitrous ether, 5 parts of tincture of allspice, 1 part of acetic ether, 2 parts of tannic acid. (The spirit of nitrous ether contains 5 per cent or less of ethyl-nitrite.) A London 'brandy improver:' acetic ether, oil of capsicum, sugar, and caramel; the oils or tinctures of cassia and cloves, and oil of bitter almond are used."

Dr. G. B. Wood, in his work on Therapeutics, remarks, "that there is little or no difference between brandy, rum and whisky, in relation to the effect of the alcohol; that medicinally, it is of but little importance; that the different forms of ardent spirits are now prepared artificially, by first obtaining rectified spirit free from fusel oil, then reducing this with water to the requisite strength, and finally giving the desired color and flavor by suitable additions."

Prune tincture used in the preparation of English brandy is made according to Muspratt (page 106) by covering fifty-six pounds of prunes, thoroughly broken up, with twenty gallons of clean spirit of wine, and after being allowed to stand for eight or ten days, rack off; the refuse fruit is washed twice with liquor, and the residue is then thrown away.

He adds, "many rectifiers, prepare a brandy flavor as follows: To one hundred gallons spirit—clean faints, fifty-four over proof—add 100 gallons of good strong vinegar, four gallons of spirit of nitre, in a tank, and mix the whole thoroughly, cover closely, and the next day run it into the still with 8 pounds of nitric acid, 10 pounds of almond cake, 5 pounds of orris root, and two pounds of lemon peel; work the still slowly, and turn off at proof strength. In making up brandy, ten per cent. of the above flavoring is employed, but more or less may be used to suit the taste of the consumer."

Cognac brandy according to Dr. Feuchtwanger, "may be produced from the best cognac or grape-oil, the œnanthic ether, the extract of grape juice, the essence of cognac or brandy flavoring from cognac oil, or the œnanthic ether; dissolve one ounce of the best cognac oil in one quart of the highest proof alcohol, and let it stand over night; the following morning add one ounce of acetic ether, one ounce oil of apple, one ounce of essence of Jamacia rum, and ten drops of the oil of bitter almonds to the alcohol; and in the cask containing 160 gallons of good proof spirits, rectified by the above prescribed method, add one gallon of syrup of gum arabic, and according to the color desired, either dark or pale brandy, one gallon of sugar coloring and one quart of the tincture of white-oak bark. From the essence of cognac, for sixty gallons by pure spirits, take one pound of the essence of cognac, one gallon of syrup of gum arabic, one gallon of sugar coloring, one quart of oak-bark tincture, one ounce of acetic ether. From the extract of grape juice; one pound of the extract of cognac, one gallon of syrup of gum arabic, two gallons of sugar coloring, 200 gallons of pure spirits. From brandy flavoring; each gallon of the brandy flavoring is put into a barrel (of 40 to 45 gallons capacity), of pure spirits (French purified spirits), and according to the color desired from one-half to one gallon of sugar coloring is added. To add, if it is desired, about five gallons of

pure imported brandy for each barrel containing the mixture, a more expensive, and perhaps also a more improved brandy, may be thereby obtained.

The Rochelle brandy is imitated by the extract of cognac: say one pound to five barrels of pure spirits, as above described and adding sufficient coloring; one-half pound essence of violet, one gallon of syrup of gum arabic, one quart of tincture of oak bark, and two gallons of Rochelle brandy for each barrel."

Ed. Schuberts practisches Recepttaschenbuch für Destillation (1877) and A. Rion sämmtliche Geheimnisse der Bierbrauerei, give the following receipts:

"Cognac (ordinaire): for thirty quarts take twenty quarts of rectified spirits of 90° Tralles, one-tenth ounce violet flower essence, five ounces raisins, ten ounces cognac essence, ten quarts water, and six ounces St. John's bread. Mix the spirit with the essences, and boil the raisins and St. John's bread in the water, filter, and mix all together, color finally with caramels."

"Cognac (fair): for thirty quarts 60° Tralles: fifteen quarts rectified alcohol 90° Tralles, seven and one-half ounces cognac essence, one-tenth ounce violet flower essence, seven and one-half quarts genuine cognac, five ounces raisins, six ounces St. John's bread, seven and one-half quarts water; prepared as the previous one.

Cognac (fine): for thirty quarts 60° Tralles: eight quarts rectified alcohol 90° Tralles, eighteen quarts genuine cognac, five ounces cognac essence, two ounces raisins, two ounces St. John's bread, one-tenth ounce violet flower essence, four quarts water, prepared as before."

W. B. Dick gives in his "Encyclopedia of practical Receipts and Processes," the following information on the manufacture of imitation brandies. Flavoring used for the manufacture of cognac brandy, etc. "Prune flavoring. Mash twenty-five pounds prunes, infuse for fifteen days with six gallons proof spirits, stirring it every day, and filter. Raisin flavoring. Subject twenty-five pounds mashed raisins to the same process as the prunes in the last recipe. St. John's bread flavoring. Cut fifty pounds St. John's bread into small pieces, infuse for fifteen days with twelve gallons proof spirits, stirring every day; filter."

"How to prepare essence of cognac. Take one ounce oil of cognac —the green oil is the best; put in one-half gallon ninety-five per cent. spirits; cork it up tight, shake it frequently for about three days; then add two ounces strong ammonia. Let it stand three days longer; then place in a stone jar, that will contain about three gallons, one pound fine black tea, two pounds prunes, having first mashed the prunes and broken the kernels. Pour on them one gallon spirits, twenty above proof. Cover it close, and let it stand eight days. Filter the liquor, and mix with that containing the oil and ammonia. Bottle it for use. This makes the best flavoring known for manufacturing brandies or for adding to such cordials, syrups, etc., as require a fine brandy flavor." (Monsert.)

To imitate brandy with essence of cognac. Take one pint essence of cognac fifteen gallons pure spirits (very fine) twenty per cent. above proof, one-half pint plain white syrup. Color with caramel.

"Highly flavored domestic brandy. To forty gallons French proof spirit add two quarts raisin flavoring, two quarts prune flavoring, two quarts St. John's bread flavoring, one gallon best Sherry wine, two

drachms oil of cognac and twenty drops oil of bitter almonds, both dissolved in a little ninety-five per cent. alcohol; one gallon Jamaica rum (or one-fourth ounce Jamaica rum essence) and two pints wine vinegar. Ten gallons of this mixture mixed with thirty gallons French spirits, makes an excellent domestic brandy and one pound of glycerine gives it age.

Imitation Cognac brandy. "To thirty-six gallons French proof spirits add four gallons Tellevoisin or Marette cognac, one-half gallon best Sherry or Madeira wine and twenty drops oil of cognac, dissolved in a little ninety-five per cent. alcohol. Then pour two quarts boiling water over two ounces of black tea; when cold, filter through flannel and add a little maraschino; mix this with the other ingredients and color whole with caramel."

"Another excellent formula is as follows: Dissolve twenty drops oil of cognac and fifteen drops oil of bitter almonds in a little ninety-five per cent. alcohol; add it to forty gallons sixty per cent. French spirit, with two pints tincture of raisins, two pints tincture of prunes, three pints best Jamaica rum, three pints best Sherry wine and one-half ounce acetic ether; color with caramel.

Imitation brandy. Take forty gallons French spirits, add to it one pint tincture of raisins, one quart prune flavoring, one-half gallon best Sherry or Madeira wine, and one pint wine vinegar. Then add one drachm oil of cognac, twelve drops oil of bitter almonds, one-eighth to one-half drachm tannin powder, each dissolved separately in ninety-five per cent. alcohol. Color to suit with caramel.

Imitation French brandy. To forty gallons French proof spirit add one quart tincture of orris root (infuse two ounces powdered orris root for twenty days in one quart ninety-five per cent. alcohol; filter), one pint vanilla flavoring (infuse one drachm sliced vanilla for twenty days in one pint ninety-five per cent. alcohol; filter), one-half gallon best Sherry or Madeira wine, and one pint wine vinegar. Dissolve separately, one drachm oil of cognac and twelve drops oil of bitter almonds each in a little ninety-five per cent. alcohol, add them to the mixture, coloring the whole to suit, with caramel.

Imitation pale brandy. Infuse one drachm star anis (breaking the star only) for eight hours in one-half pint ninety-five per cent. alcohol, and filter; add this to forty gallons proof spirits; then add one-half gallon best Jamaica rum, and one pint of the best raspberry syrup. Dissolve one drachm oil of cognac and twelve drops oil of bitter almonds, separately, in a little ninety-five per cent. alcohol, and mix them with the whole.

In "Secret Wealth," compiled by Watson Johnson, Syracuse, 1875, among others, the following recipes are given:

"French brandy," pure spirits, one gallon, best French brandy one quart, loaf sugar two ounces, sweet spirits of nitre one-half ounce, a few drops of tincture of catechu or oak bark to roughen the taste if desired. (Page 99.)

"Pale brandy," the same only using pale brandy instead of French, and one ounce of tincture of kino for every five gallons.

"Cognac brandy."–To every 10 gallons of pure spirits add two quarts New England rum or one quart Jamaica rum and from 30 to 40 drops of oil of cognac cut in one-half pint of alcohol; color with burnt sugar.

"Brandy." — To 40 gallons of pure neutral spirits, add one pound of

crude tartar dissolved in one gallon of hot water; acetic ether one-quarter pound, bruised raisins six pounds, tincture of kino 2 ounces, sugar three pounds, color with sugar coloring; let stand for 14 days and then draw off.

The following recipes, etc., have been taken from the price-list of a manufacturing establishment (cognac oils, essences, ethers and flavororing extracts).

"To produce a good imitation of cognac, a good cologne spirit, which is double-distilled and rectified and therefore entirely free from fusel oil, should be used, though other spirits and whiskeys will answer the purpose, but will not yield as good a quality."

"Cologne spirit is made as high as alcohol, say 188 per cent. and must be reduced with distilled or rectified water; it is however sold by distillers at any proof required."

"Neutral or proof spirit, which is made by re-rectifying the double-rectified whiskey, is next best to cologne spirit for brandy, etc. Double-rectified whiskey is used for imitation Rye, Bourbon or Monongahela whiskey, bitters, New York gin and New York brandy, but reduced, alcohol should never be used. All manufactured liquors will improve by age; as a substitute for age, it will be found of great advantage to cut the oils and essences well in alcohol and to keep them in air-tight jars as long as possible."

"Cognac, from our finest cognac oil, distilled from grapes; take, to 40 gallons of the best cologne spirit proof, one-sixth of one oz. of the cognac oil, well cut in one pint of alcohol, one and one-half pint sugar syrup and fou1 oz. of our sugar coloring."

Brandy, from œnanthic ether; 4 oz. œnanthic ether, one oz. Jamaica rum essence, one and one-half pint sugar syrup and 4 oz. of our sugar coloring.

Rochelle	brandy	4	ounces	of essence	to	40	gallons	of proof	spirits.
Otard	"	4	"	"	"	40	"	"	"
Cognac	"	4	"	"	"	40	"	"	"
Signette	"	4	"	"	"	40	"	"	"
Catawba	"	8 to 10	"	"	"	40	"	"	"
Apple	"	6	"	"	"	40	"	"	"
Cider	"	8	"	"	"	40	"	"	"
Peach	"	5	"	"	"	40	"	"	"
Cherry	"	8	"	"	"	40	"	"	"
Rice	"	1 pound	"	"		50	"	"	"

and one pint of sugar syrup.

In this connection I may be permitted to give the preparation of the so-called wine oil, Hungarian wine oil, or cognac oil. As early as 1852, H. Schwartz, in Breslau found that an essence sold under the name of Ungarwein oil and used for the manufacture of cognac, consisted mainly of œnanthic ethyloxide (Wagner's Jahresbericht der chemisch. Technologie, 3. Jahrgang, 1857, p. 320). A. Rauter gave in the same year the following information in regard to the manufacture of the lees, or wine oil on a large scale. For every 100 pounds of yeast (lees) Rauter takes one to one and a half pails of water, and one-half pound of sulphuric acid. After the distillation is over he adds to the residue for every pound of sulphuric acid employed, 3 pounds crystallized carbonate of soda, to

partly neutralize the acid. After 8 days the crystallized cream-tartar is separated by a sieve from the smeary mass; and from the latter a fine black color is obtained after heating it to redness. There is obtained, besides variable quantities of alcohol and coloring matter, one pound of wine oil and from 150 to 200 pounds of raw cream tartar from 2500 pounds of lees. (P. 321).

Essence of cognac and wine. (Am. chemist. December 1872, P. 235.) 'The odor of this essence is chiefly due to the presence of pelargonic ether. This is made by oxidation with nitric acid of the essence of rue (obtained by distillation from the ruta graveolens), by which means pelargonic acid is obtained. This is treated with potassa and sulphuric acid which purify it, and is then mixed with alcohol, and hydrochloric acid passed into it, which causes, the formation of pelargonic ether."

My object in giving the above recipes has been to furnish such information as to the method and the material used in the manufacture of artificial brandies, etc., as to enable one to decide to what extent these artificial products may be injurious to the health.

Of the material employed the most *objectionable* is unquestionably the oil of bitter almonds, since it happens occasionally that this oil contains considerable quantities of prussic acid, as the writer well knows from practical experience. Moreover it may happen, and it undoubtedly does happen, that nitro benzol — artificial oil of bitter almond,— is used in place of the genuine oil of bitter almonds, which is still more dangerous, since this substance in the presence of alcohol is very readily absorbed into the blood, "a few drops constituting a poisonous dose." (Prescott.) Hence the use of the impure oil of bitter almonds, and especially the use of artificial oil of bitter almonds or nitro-benzol, for the manufacture of liquors should be prohibited by law.

In the manufacture of *liquors* and *spirits* the product of the first distillation — the raw spirits — is too impure to be used as a beverage, hence it has to be rectified and purified to remove excess of fusel oil, etc. This is usually done by a redistillation at a low temperature or by passing it several times through peculiarly constructed filters, made with animal bone-black, manganese, pine wood charcoal, calcined magnesia, sand, etc., or it may be accomplished by both methods combined. Often before redistillation, the liquors are treated for from 10 to 12 hours with six pounds of oak bark, one-half pound of purified sal tartar, and one-fourth pound slacked lime per barrel, after which about three-fourths of the total amount of liquor employed is distilled over. As another method to purify raw spirits it is recommended to add to a barrel of 40 gallons, 4 ounces of pure sulphuric acid and mix well, allow to rest for three days, and then add 12 ounces of sal soda dissolved in a little water, mix thoroughly and test with litmus paper to see if neutral. To give a stronger taste to spirits, Dr. Feuchtwanger recommends the addition of "about two ounces of chloride of lime, rubbed up with a little sal soda, and add this in solution to the spirit."

"*Bead for Liquor.*"—"The best bead is the orange flower water, oil of neroli 1 drop, to each gallon."

"To every 40 drops of sulphuric acid add 60 drops of the best sweet oil, in a glass vessel; use immediately. This quantity is usually sufficient for 10 gallons of spirits."

Take one ounce of purest oil of sweet almonds, one ounce of sulphuric acid, and put them into a stone mortar, add by degrees two

ounces of lump sugar, rubbing it well with the pestle till it becomes a paste, then add small quantities of spirits of wine until it becomes a liquid; this quantity is sufficient for 100 gallons; the first is strongly recommended as the best. "Secret Wealth," Watson Johnson, p. 104.

Analysis of Brandy.

Twenty-five samples of brandy were received from the State Inspector, and were examined with the following results: In regard to color there was very little difference, the prevailing shade being amber, from pale to almost dark. The odor of brandy in most of them was fair but not very prominent. Free sulphuric acid, tested for as explained under wine, could not be detected in any one of these samples. The same must be said in regard to combined sulphuric acid, only a mere trace being found in one sample, which was undoubtedly due to the water used for the production of the liquors.

Results of the Examination of Samples of Brandy.

Number of the State Inspector.	Reaction.	Specific Gravity with temperature at which taken.	Alcohol.		Solid Residue at 212° F.	Ash.
			By volume. Per cent.	By weight. Per cent.	Per cent.	PerCt
199	Acid	.9614 at 26.5° C.	30.80	25.39	0.163	0.008
200	Acid	.9600 at 21° C.	32.60	26.94	0.095	0.004
201	Neutral	.9579 at 21° C.	34.60	28.67	0.035	0.005
202	Slightly acid	.9579 at 24° C.	34.50	28.59	0.089	0.002
203	Slightly acid	.9435 at 25° C.	43.80	36.83	0.081	0.005
204	Acid	.9428 at 21° C.	44.70	37.64	0.430	0.012
205	Neutral	.9472 at 23° C.	41.60	34.84	0.067	0.006
206	Neutral	.9539 at 22° C.	34.60	28.67	0.142	0.003
207	Acid	.9506 at 21° C.	39.60	33.06	0.165	0.007
208	Almost neutral	.9444 at 26° C.	42.40	35.58	0.608	0.009
209	Acid	.9322 at 23° C.	49.90	42.44	0.402	0.007
210	Neutral	.9594 at 24° C.	33.20	27.47	0.136	0.003
211	Slightly acid	.9389 at 23° C.	46.70	39.48	0.745	0.005
212	Neutral	.9615 at 23° C.	31.40	25.91	0.113	0.005
213	Slightly acid	.9590 at 22° C.	33.60	27.80	0.058	0.006
214	Slightly acid	.9508 at 20° C.	40.20	33.63	0.103	0.008
215	Acid	.9391 at 21° C.	46.40	39.23	0.285	0.004
216	Very slightly acid	.9586 at 21° C.	33.10	27.40	0.109	0.003
217	Almost neutral	.9421 at 23° C.	44.00	37.00	1.469	0.009
218	Acid	.9579 at 23.5° C.	34.60	28.67	0.075	0.004
219	Acid	.9509 at 25° C.	38.40	32.24	0.103	0.007
220	Slightly acid	.9500 at 21° C.	40.20	33.63	0.091	0.009
221	Neutral	.9466 at 21° C.	42.80	35.92	0.025	0.004
222	Slightly acid	.9433 at 24° C.	43.20	36.38	0.148	0.006
223	Acid	.9297 at 25.5° C.	50.40	42.96	1.795	0.014

None of the samples contained chlorine; and in no case did I find lead, copper, zinc, antimony or arsenic.

The amount of alcohol in these twenty-five samples of brandy varies very considerably, hence the necessity of having a proper standard established by law.

Fehling's solution was applied directly for the detection of grape sugar; five samples showed considerable grape sugar, the rest very little; in none was it entirely absent.

Acetate of lead was added for the detection of certain coloring matters. These samples gave heavy precipitates, with colorless filtrates; Nineteen samples gave very slight precipitates and colored filtrates; three gave no precipitates.

Fehling's solution, applied to filtrate after adding acetate of lead gave a slight reduction in eight samples only.

Albumen gave brownish precipitates with the tannin, in all cases, the filtrate being colored in two cases only.

A portion of each sample was evaporated on a water-bath to about one-tenth, and the residue tested as follows:

a. The taste was sweet in eleven cases, astringent in three cases, not decided in the other samples.

b. The reaction was slightly acid in twelve cases, neutral in the others.

c. Ferric chloride showed considerable tannin in seven samples, and a very little in the others.

d. Gelatin gave a strong reaction for tannin in two samples, a decided reaction in eight, slight in four, none in eleven.

e. Fehling's solution showed grape sugar at once in fifteen samples, and gave a slight indication for grape sugar in all the others.

In testing for fusel oil with anilin oil and hydrochloric acid, sixteen samples gave a distinct reaction, six contained traces, and in three there was none.

The presence of oil of bitter almonds, nitro benzol, nitrous ether, etc., could not be proved in any of the samples under examination.

From the examinations made, it is quite clear that the manufacturers of artificial brandies, add those ingredients which are found in the natural product. The main distinguishing characteristics between the genuine and artificial products (or such as have been tampered with), are the flavor or aroma, the amount of alcohol, solid extract, ash, acidity, coloring matter and tannic acids.

Whiskey.

Pure whiskey, like pure brandy, is a diluted alcohol with a peculiar flavor or aroma, due to the raw material employed in its manufacture, and developed during the fermentation, distillation and ageing of the liquor, as stated and explained under brandy.

The sources for the manufacture of whiskey are manifold, and whiskey has received certain names partly from the material from which it is made, as malt, wheat, rye, corn, potatoes, etc., and partly from the country or locality in which it is made as Scotch, Irish, Bourbon, Monongahela, etc., whiskey.

The raw materials usually employed in the manufacture of whiskey are, malt (made mostly of barley), barley, rye, wheat, oats, corn and potatoes; since these substances contain only very small quantities of sugar, it is evident, that the first operation of the brewer and distiller consists in the changing of the starch in these substances into sugar. This is accomplished by the action of a peculiar ferment called "diastase," during the process of mashing. The saccharifying power of the diastase (especially in the malt made of barley) is very great, and as it can change much more starch than is contained in the malt, raw grain is usually employed together with the malt in the proportion of one of the latter to from five to nine of the former. Moreover, it is not unusual to employ several kinds of grain, thus the Scotch distillers use two parts of malt, one part of oats, one part of rye, and seven parts of barley. The Irish distillers take two parts of malt, one part of oats, and seven parts of barley. English distillers often take twelve parts of malt, sixteen parts of oats, and one hundred and twelve parts of barley.

Dr. Johnson in his "Chemistry of Common Life" gives the following proportion: Malt 42 bushels at 40 pounds; oats 25 bushels at 47 pounds; rye 25 bushels at 53 pounds; barley 158 bushels at 53 pounds.

The diastase in the 42 bushels of malt, converts into sugar the starch of the whole 250 bushels weighing eight times as much as the malt itself. This quantity of grain yields on an average 583 gallons of proof whiskey, or 14 gallons from 6 bushels of the mixture. In an Irish grain distillery the components of the mixture for fermentation were:

	I.		II.		III.	
	Bush.	per cent.	Bush.	per cent.	Bush.	per cent.
Malt	280	14	240	12	80	14.25
Oats	320	16	280	14	120	21.50
Rye	600	30	320	16	80	14.25
Barley	800	40	920	46	280	50.0
Maize	...	..	240 —	12	...	.....

The time for mashing, as well as the temperature of the mash during that time, varies according to the object in view, and the raw material employed. To obtain the highest amount of alcohol, a low temperature must be maintained during mashing. When the saccharifying process is finished the resultant sugar solution is cooled to the proper temperature, and fermentation is induced by the addition of yeast. When fermentation ceases, distillation is commenced at once to prevent the acidification, souring of the alcoholic liquids. The resultant distillate, the raw whiskey, is purified to remove fusel oil, etc., in various ways, especially by rectification over charcoal and re-distillation as stated previously under brandy, the first portion of the distillate being usually sold as whiskey. When the fermentation of the saccharine fluid takes place at a low temperature or in the presence of tartaric acid, little or no fusel oil, amyl alcohol is formed. The peculiar flavor of Irish and Scotch whiskeys, is due in the first case to the employment of peat or birch wood in drying the malt, and in the second, to certain empyreumatic oils which distil over with the spirit.

In regard to the manufacture of distilled spirits, Rudolf Wagner says (Chemical Technology, 1872, p. 424): "Originally, that is to say when spirits (now some two and a half centuries ago), were first commenced to be made industrially on the large scale, it was only made for the purpose of being drunk, and the liquor prepared in the comparatively dilute state in which it is offered for sale for consumption. More recently (within the last forty or fifty years) the use of alcohol in various branches of industry is so great, that as a rule distillers *at once* prepare strong alcohol, which if required for consumption as a beverage, is suitably diluted and sweetened if desired." All distilled spirits are usually sold at what is called the proof standard. A spirit is "proof," according to the United States government regulation, when it contains fifty per cent by volume of absolute alcohol. The English standard requires about fifty per cent of alcohol by weight (specific gravity of the former at sixty deg. Fahrenheit 0.9348, and of the latter at the same temperature 0.9190). The English standard was established according to an Act of Parliament, and "when (in England) spirit is said to be thirty per cent above proof, it means that one hundred parts of this spirit and thirty parts of water will yield one hundred and thirty parts

of proof spirit, and when spirit is said to be thirty per cent under proof, it means that one hundred parts of this spirit contains one hundred minus thirty, or seventy parts of proof spirit.

According to R. Wagner, 100 parts of starch should yield 56.78 of alcohol; 100 parts of cane sugar should yield 53.80 of alcohol; 100 parts of dextrose should yield 51.01 of alcohol.

In practice it is of course less, thus according to the same author: 100 kilos (at 2.2 bbs) of barley give 44.64, liter (at 2.2 pints) spirit at 50 deg. Tralles; 100 kilos (a 2.2 bbs.) of barley malt give 54.96 liter (at 2.2 pints) spirit at 50 deg. Tralles; 100 kilos (at 2.2 bbs) wheat give 49.22 liter (a 2.2 pints) spirit at 50 deg. Tralles; 100 kilos (at 2.2 bbs.) of rye give 45.80; liter (at 2.2 pints) spirit at 50 deg. Tralles; 100 kilos (at 2.2 bbs.) of potatoes give 18.32 liter (at 2.2 pints) potato spirit at 50 deg. Tralles.

According to Mr. Young, of the English inland revenue, the average is for one quarter (8 bushels) of barley malt, 13 gallons of proof spirit; for one quarter (8 bushels) of malt grain, 20 gallons proof spirit; for one cwt. sugar 10 gallons of proof spirit; one cwt. molasses 7 gallons of proof spirit, one cwt. of rice 7½ gallons of proof spirit; one ton beet root, fifteen gallons of proof spirit.

Of mixed grains according to seasons, one gallon of proof spirit requires from 17¼ to 20½ pounds (the mixture consisting of malt twelve parts, oats sixteen parts and barley 112 parts.)*

It is stated "that about three-fifths of the product of distillation in the United States is what is termed high wines or whiskey, containing about seventy-five per cent of alcohol. Some of it is made into cheap whiskey and the remainder into French spirit." About one-fifth is alcohol used in the arts and manufacture, and the other fifth consists of whiskey and rum distilled to about proof and so left to ripen with age.

Dr. J. Koenig (1) quotes from H. Grouven the following kinds of whiskey and their strength:

Name.	Alcohol. Vol per cent.	Wgt. per cent.
Russian dobry wutkey............	62.0	54.2
Scotch whiskey..................	50.3	42.8
Irish whiskey....................	49.9	42.3
English whiskey.................	49.4	41.9
German schnaps..................	45.0	37.9
American whiskey................	60.0	52.2

Prof. James Babcock (2) gives the alcohol strength of ten samples of "Bourbon whiskey" as from 44.5 to 51 per cent of alcohol by volume; one sample of "rye whiskey" as 49 per cent; and of 257 samples of ordinary whiskey as from thirty to fifty-nine per cent of alcohol by volume.

Mr. M. U. Green (3) gives the following:

1. "Three years old "rye whiskey," wholesale price $1.10 per gallon,

* British manufacturing industries, brewing and distilling by T. A. Tooley, page 218—London 1876.

(1) Nahrungs-und Genussmittel, 1879, vol. I, p 187.

(2) First and Second annual report as assayer of liquors to the Commonwealth of Massachusetts.

(3) American Chemist, 1876, p. 46.

dark amber color, acid reaction, very pleasant odor and slightly astringent taste. Ethyl alcohol 32.5 p. c. by weight; a small quantity of fusel oil; 0.003 p. c. of acetic acid; a very little tannic acid; odor and flavor by presence of tonka bean and bitter almond oil (natural). Sugar was found, and the odor of maple sugar thought to be recognized. The solid residue was 0.379.

2. "Two year old rye whiskey," of light amber color and natural reaction. Alcohol 34.2 p. c. by weight; fusel oil, a trace; tannic acid, a trace; caramel and sugar 0.002 p. c.; sodium sulphate and acetates, traces; solid residue 0.17 p. c.

3. "Three years' old rye whiskey," dark amber color, and reaction. Alcohol 40.6 p. c. by weight; fusel oil, a trace; acetic acid, 0.002 p. c.; tannic acid, a trace; sugar 0.005 p. c.; solid residue, 0.16 p. c. The residue had a slightly bitterish as well as astringent taste.

4. "Old rye," $6 per gallon at retail, dark amber color; strong acid reaction; fine etherial aroma remaining after the alcohol has evaporated. Alcohol 51.2 p. c. by weight; fusel oil, a trace; acetic acid, 0.0012 p. c.; tannic acid, 0.0003 p. c.; sugar, a trace; solid residue 0.73 p. c.

5. "Pure old bourbon," dark amber color, strong acid reaction; alcohol 49.2 p. c. by weight; acetic acid, 0.0024 p. c.; tannic acid, a trace; solid residue, very slight. This specimen was believed to have been flavored with burnt dried peaches.

Adulteration and Imitation of Whiskey.

The following recipes are taken from various sources:

"*Bourbon whiskey*. To 100 gallons of proof spirit, add four ounces of pear oil, two ounces of pelargonic ether, thirteen drams oil of wintergreen dissolved in ether, one gallon of wine vinegar, color with burnt sugar."

"*Monongahela whiskey*. Common whiskey, thirty-six gallons; dried peaches, two quarts; rye ground and burnt like coffee, one quart; cinnamon, cloves and allspice, bruised, of each one ounce; loaf sugar, five pounds; sweet spirit of nitre, two ounces; put these into four gallons of pure spirits, shake every day for one week, then draw off and add the whole to the thirty-six gallons of whiskey."

Another. "To 20 gallons of pure proof spirit add two pounds of dried peaches, two pounds of white sugar, one pint of burnt and ground rye, two ounces ground allspice, four ounces ground cinnamon, one ounce ground cloves. Infuse all the above ingredients in the spirits for five or ten days and then draw off."

Old Rye. "Take dried peaches, one-half peck, soak and roast them in a stove but do not burn them; bruise and put them into a woolen (pointed) bag and leach good common whiskey over them twice slowly, sufficient for one barrel; add afterward twelve drops of aqua ammonia to each barrel and with age you will have whiskey equal to old rye."

Another. "To 50 gallons of pure proof spirit add two ounces of pelargonic ether, one ounce of pear oil, ten drops oil of wintergreen, dissolved in 95 deg. alcohol, four ounces acetic ether, four drops oil of cloves dissolved in the acetic ether, color, if necessary, with burnt sugar."

Scotch whiskey. "To 46 gallons of 95 deg. alcohol add eight gallons best Scotch whiskey, eighteen gallons soft water, three pounds clarified

honey dissolved in one and one-half gallon of soft water, five drops of creosote dissolved in two ounces of strong acetic acid, one ounce pelargonic ether and one gallon of old ale."

Another. "To 35 gallons of pure spirit ten degrees over proof add fifteen gallons of best genuine Scotch whiskey, three drops creosote mixed with one ounce of acetic acid, and one ounce acetic ether."

Irish whiskey. "May be made by substituting Irish for Scotch whiskey in the preceeding recipe."

Irish whiskey. "To 30 gallons of pure spirit ten degrees over proof add five gallons of genuine Irish whiskey, one-half gallon old ale, four drops creosote in an ounce of acetic acid, and one ounce of pelargonic ether."

Scotch and Irish whiskey. "To 40 gallons of pure spirit add five gallons of Scotch or Irish whiskey, one-quarter ounce creosote dissolved in one quart of alcohol, one pound of loaf sugar, let stand for ten days."

Old Bourbon whiskey. "To 40 gallons of spirit add five gallons of good Bourbon whiskey, spirit of nitre two ounces, fusel oil from corn two ounces in one quart of alcohol; let stand four days."

"In order to convert a corn whiskey into a rye whiskey, add to four barrels of the corn whiskey one pound of the essence of Monongahela, one ounce of sweet spirits of nitre, one gallon syrup of gum arabic."

Bourbon whiskey. "One pound of the essence of Bourbon, one ounce of sweet spirits of nitre, one gallon of syrup, four barrels of common rectified corn whiskey."

Irish whiskey. "One pound of the essence of Irish whiskey, one ounce of sweet spirits of nitre, one-half gallon of syrup of gum arabic, four barrels of good whiskey either rye or corn."

Scotch whiskey. "One pound of the essence of Scotch whiskey, one ounce of sweet spirits of nitre, one-half gallon of syrup of gum arabic, four barrels of common whiskey."

Imitation of Bourbon whiskey. "Mix together 40 gallons proof spirits, one-half gallon peach flavoring (steep for one month ten gallons dried peaches, ten gallons oak sawdust, and five pounds black tea, in 40 gallons proof spirits; strain and filter) one-half gallon hickory nut flavoring (crush one bushel hickory nuts and infuse for one month in twelve gallons of 95 per cent alcohol; strain and filter), one-half gallon highly flavored brandy (given under brandy), one pint wine vinegar and one pint white glycerine. Add to these twelve drops oil of cognac dissolved in 95 per cent alcohol, and color with caromel."

Or: 36 gallons proof spirits, four gallons highly flavored proof rye whiskey, one gallon domestic brandy (given under brandy), together with the same proportions of vinegar glycerine and oil of cognac as before."

Another. "To 36 gallons proof spirits add four gallons highly flavored proof Bourbon, one gallon New England. rum, one-half gallon sweet Catawba wine (or one quart sherry wine), and one pound white glycerine; color to suit with caromel."

Another. "To 36 gallons proof spirit, add four gallons highly flavored proof Bourbon, one gallon malt whiskey, one pint wine vinegar, one pint syrup and twelve drops oil of cognac dissolved in 95 per cent alcohol; color with caromel."

Another. "To 40 gallons proof spirit, add one gallon hickory flavor, one gallon domestic brandy, one pint wine vinegar, and one pound white

glycerine, with twelve drops oil of cognac dissolved in 95 per cent alcohol; and caromel sufficient to color."

Copper distilled Bourbon whiskey. "Dissolve one dram sulphate of copper in one-half pint of water, filter, and add it to forty gallons proof spirit, with one gallon peach flavor, one gallon brandy flavor (mash 25 pounds raisins, 12 pounds prunes, 6 pounds figs, and one pineapple sliced; infuse for 15 days in 20 gallons proof spirits; stirring every day and then filter), one pint wine vinegar, one pound white glycerine and twelve drops oil cognac dissolved in 95 per cent of alcohol; color with caromel."

Rye whiskey. "To 40 gallons proof spirit add two gallons peach flavoring, one pint white vinegar and twelve drops oil of cognac in 95 deg. alcohol; color with caromel."

Sweet rye whiskey. "To 30 gallons proof spirit, 10 gallons proof rye whiskey and one gallon raisin flavor, colored with sufficient caromel."

Irish whiskey. "To 36 gallons French spirits, 20 above proof, add four gallons Scotch (Ramsey) whiskey, three pints best sherry wine, two pints syrup and ten drops sassafras flavor (granulate one-half pound sassafras bark and infuse it in one-half gallon 95 per cent alcohol for twenty days and then filter)."

Scotch whiskey. "To 36 gallons French spirits, twenty above proof, add four gallons Scotch whiskey and one quart syrup."

The manufacturers of essences recommend the use of their essences usually with some coloring.

To improve the flavor of new whiskey. "Take a gallon of whiskey and four ounces of tea, four ounces of allspice, four ounces of carraway seed, two ounces cinnamon, shake occasionally for one week, use one pint per barrel."

To purify whiskey. "To forty gallons whiskey add one and one-half pounds unslacked lime, three-fourths pound alum, and one-half pint spirits of nitre, let stand for twenty-four hours and then draw off."

The most objectionable additions to whiskey recommended in these recipes are undoubtedly creosote and sulphuric acid and their use should be prohibited by law.

Analysis of Whiskey.

In regard to the analysis of whiskey I can refer to the methods given under brandy.

The detection of the most common adulterants has been given under brandy to which I must refer, except in regard to creosote, which should be extracted either with ether or petroleum naphtha, and after evaporation of the solvents may be best recognized by its odor.

The results of my examination of twenty-five samples of whiskey, submitted, are given in the following table. It is evident that the addition of water and coloring matter is practiced more than any other adulteration. No free sulphuric acid could be found, and in only two samples could a reaction for sulphates be obtained.

Results of the Examination of Samples of Whiskey.

State Inspector's Number.	Reaction.	Specific Gravity by Pycknometer.	Alcohol. By volume. Per cent.	Alcohol. By weight. Per cent.	Solid Residue. at 212° F. Per cent.	Ash. Per Ct.
124	Acid	.9582 at 20° C.	36.60	30.40	0.7520	0.0235
125	Neutral	.9518 at 27° C.	36.80	30.57	0.0550	0.0030
126	Slight acid	.9511 at 24° C.	38.30	31.91	0.0990	0.0050
127	Neutral	.9645 at 21° C.	29.90	24.60	0.1470	0.0050
128	Slight acid	.9525 at 22° C.	38.30	31.91	0.1190	0.0080
129	Slight acid	.9587 at 24° C.	34.00	28.13	0.0980	0.0060
130	Slight acid	.9500 at 23° C.	39.20	32.72	0.1660	0.0060
131	Slight acid	.9343 at 23° C.	48.50	41.16	0.2580	0.0080
132	Neutral	.9539 at 23° C.	36.60	30.40	0.1650	0.0020
133	Slight acid	.9562 at 22° C.	36.20	30.07	0.1365	0.0065
134	Slight acid	.9555 at 22° C.	35.60	29.41	0.1070	0.0230
135	Neutral	.9585 at 22° C.	35.20	29.19	0.0630	0.0280
136	Slight acid	.9428 at 24° C.	44.20	37.22	0.5485	0.0045
137	Neutral	.9249 at 20° C.	53.20	45.63	0.2460	0.0130
138	Neutral	.9569 at 20° C.	36.80	30.57	0.0998	0.0060
139	Neutral	.9592 at 21° C.	33.00	27.27	0.3730	0.0090
140	Slight acid	.9593 at 23° C.	34.20	28.34	0.0680	0.0040
141	Neutral	.9398 at 22° C.	44.00	36.99	0.1130	0.0080
142	Neutral	.9536 at 23° C.	37.00	30.74	0.0950	0.0030
143	Slight acid	.9550 at 24° C.	36.40	30.24	0.1000	0.0060
144	Neutral	Not taken.	28.90	23.75	0.0550	0.0050
145	Neutral	.9473 at 27° C.	39.70	33.14	0.0120	0.0060
146	Slight acid	.9596 at 21° C.	32.70	27.02	0.1800	0.0086
147	Acid	.9018 at 25° C.	60.30	52.58	0.2920	0.0070
148	Acid	.9114 at 23° C.	60.30	52.58	0.3190	0.0080

Slights traces of chlorine were detected in eighteen samples, probably due to common salt.

Fehling's solution showed grape sugar in all the samples.

Fusel oil was decidely present in twenty samples, and a slight indication was had in all the others.

Acetate of lead gave a heavy colorless precipitate in two samples, a slight colored precipitate in seventeen samples, none in the others.

Albumen gave a heavy precipitate in seven samples, and a slight precipitate in all the others. The filtrate was colored in seven samples, almost colorless in the rest. A portion of each sample was evaporated to about one-tenth, and the residue was tested as follows:

a. The taste was sweet in six samples, sweet astringent in two samples, slightly bitter in one, slight and not characteristic in all the others.

b. The reaction was acid in six samples, slightly acid in four, neutral in the rest.

c. Ferric chloride gave a strong reaction for tannin in four samples, a decided reaction in twelve, a slight reaction in eight; none in the rest.

d. Gelatin gave a reaction for tannin in fifteen samples, showed traces in five, none in five others.

e. Fehling's solution indicated grape sugar strongly in five samples, clearly in eighteen more, showed traces in two, none in one.

Rum.

When the juice of the sugar cane, the molasses or the refuse obtained in the manufacture of sugar, are allowed to ferment, and the fermented liquor subsequently distilled, an alcoholic liquor is obtained, known under the name of "rum," which differs from all other alcoholic liquors in its peculiar aroma. Genuine "rum" then is a by-product of the cane sugar manufacture.

Pure rum, like the previously mentioned liquors, consists of alcohol, water, aromatic substances and more or less coloring matter due to the

oaken barrel in which it is kept. The aroma in this, as in all other liquors is due to the volatile products of distillation; and it requires only a very small quantity of them to impart to a liquor its peculiar flavor.

This peculiar flavor or aroma causes the specific difference in our alcoholic drinks.

The countries that especially produce rum are, the West and East Indies, America, both South and North, and France. Its manufacture does not differ much from that of the other liquors; but special attention must be paid to the temperature of the liquid during the process of fermentation, so that the acetous (or souring) fermentation does not set in, in consequence of the elevated temperature, to which usually the fermenting liquid rises during this process. The addition of yeast is usually unnecessary; in its place the planters in the West Indies employ a liquid called "dunder." This ferment consists of the lees and feculencies of former distillations, and is usually preserved from year to year, since when stored it soon becomes covered with a thick film, and thus the air is excluded. To this is attributed the fine aroma of the genuine rum. "The richness of flavor peculiar to this spirit, and which has rendered it famous in all parts of the world, is undoubtedly derived from the raw juice and fragments of sugar cane, which are mashed and fermented with the other material in the tun." (Muspratt.) Whether any influence on the aroma can be attributed to the addition of carbonate of potash, saltpetre, salt, or sea-water to the fermenting liquid, I am unable to state; but this much seems to be certain, that a liquor made from sugar has not the natural aroma of genuine rum. Muspratt says: "The Chinese, who prepare the famous arrack of Batavia, which, without contradiction, is the best of all rums, take much care in rectifying it, mixing with it during distillation a composition called ragie, in which is cinnamon and anise-seed, in such proportion as not to be perceived either by smell or taste, being only sufficient to do away with the otherwise nauseous odor of the liquor. The Madagascars throw in leaves of trefoil; the Asiatics mix with it the bark of a kind of thorny acacia, called pattag. Some persons put into the still, with the grape, the leaves of a tree named *attier* in the East Indies, and *pommier-canelle* at St. Domingo—ænona squammosa—which have a light, agreeable odor. Others have tried, with success, the mixture of peach leaves. All these substances impart to strong liquors *a pleasant bouquet and taste*, which proves that they are used to disguise the smell of the spirit and give it unctuousness." The use of pine-apples and guavas in the manufacture of rum in the West Indies, to give age to the product, is a well-known fact.

Rum, like all distilled spirits, is a colorless liquid as it comes from the still, and whatever color genuine rum (or any other distilled liquor) does possess, is obtained with age, and is due entirely to the cask in which it is kept, and rarely exceeds a light brown or amber tint. It may seem strange, but it is an undeniable fact, that the public mind puts much stress on the color of a beverage. The darker the color of a liquor or beer, the greater is the strength and age, in the opinion of most people, hence the custom of many manufacturers of rum to color their product at once, either with molasses or caramel (burnt sugar); and although both are perfectly harmless in themselves and are added only in very small quantities, their addition is a fraud on the community, if not an adulteration. To save expenses for freight in shipping rum, it is not uncommon for rum manufacturers to make their product very high in al-

coholic strength, which is afterward by the wholesale dealers reduced to the proper strength with water; that the fine aroma by such proceedings suffers considerably it is almost unnecessary to state.

Analyses of Rum.

In Dr. J. König's book, "Die Menschlichen Nahrungs-und Genussmittel, etc.," the following analyses are recorded:

H. Grouven gives for rum, by volume, 49.7 per cent. alcohol; by weight, 42.2 per cent. alcohol.

J. König found in 100 cubic centimeters rum, specific gravity, 0.9378; alcohol by volume, p. c. 51.40; alcohol by weight, p. c. 43.7; extract, p. c. 1.260; ash, p. c. 0.059.

In the organ "Wieder die Nahrungsfälscher, Heft 7, Jahrgang iv, Juli, 1881, p. 105, Privatdocent Heinrich Berkhurts says: "to bring the problem to distinguish between genuine and spurious (*façon*) rum at least a step nearer its solution, I have examined a number of samples of unquestionable purity, and also artificial products, in regard to their specific gravity, alcohol, water and ash."

The following are his results:

	Jamaica Rum.	Specific gravity.	Percentage of Alcohol. By vol.	By weight.	Extract. matter or tot. sol. mat.	Ash.
1.	From docks of London,	0.885	75 p. c.	61.38 p. c.	0.668 p. c.	0.023 p. c.
2.	" " Glasgow,	0.875	75 "	61.38 "	4.800 "	0.089 "
3.	" Bremen, ...	0.875	90 "	74.07 "	0.568 "	0.031 "
4.	Directly imported, ...	0.910	63 "	51.33 "	2.047 "	0.098 "
5.	From Bremen, ...	....	75 "	61.38 "	0.031 "	0.025 "
6.	" "	0.870	63 "	51.33 "	.... "	.... "
7.	Out of a store in Braunschweig	0.875	75 "	61.38 "	.... "	.... "
8.	From the same source..	0.875	75 "	61.38 "	.... "	.... "
9.	Artificial product	....	48 "	38.94 "	0.469 "	0.033 "
10.	Similar one....	....	72 "	58.86 "	0.926 "	0.021 "

Prof. James Babcock gives in his two reports, the alcoholic strength of 80 samples of rum as follows:

49	Samples of rum,	Alcohol by vol.	from	33.	p. c.	to 54.0	p. c.
8	" Medford rum,	" "	"	47.5	"	" 50.0	"
4	" N. Eng. "	" "	"	49.	"	" 50.1	"
1	" Jamaica "	" "	"	..	"	" 50.0	"
7	" Cherry "	" "	"	Not given.			
11	" New "	" "	"	47.5	p. c.	to 50.2	p. c.

For the methods of analysis I must refer to my previous remarks on the subject under wine, brandy and whiskey.

Adulteration of Rum, Artificial Rum, etc.

That rum, like all other alcoholic beverages, is subject to adulteration, is undeniable. Prof. Prescott says on the subject in his "chemical examination of alcoholic liquors:" "Rum was originally distilled from fermented juice of sugar cane, and is now made to some extent from the residues and skimmings of sugar manufacture, but is mostly made of grain spirit with flavoring additions. Butyric ether (pineapple oil) is the characteristic flavor added to rum. Butyric acid is also often added

and with the dilute alcohol it forms butyric ether. The flavor is sometimes obtained by adding sliced pineapples to the spirit. The 'rum essence,' prepared to add to grain spirit and make rum, is made up of various substances, including many which are also used in 'brandy essence.'"

The addition of water or diluted alcohol (French spirit) to rum is practiced almost universally by common retail dealers all over the country. Artificial rum — façon rum — is prepared from diluted alcohol (reduced high wines), acetic ether, butyric ether, essence of violet flowers, decoction of raisins, St. John's bread, and oak bark, sugar-coloring, catechu tincture, etc. According to Dr. F. Elsner a rum essence is prepared by mixing together 15 parts of butyric ether, 2 parts acetic ether, 2 parts vanilla tincture, 2 parts essence of violet and 90 parts of 90° Tralles alcohol. This is mixed with a decoction of raisins and St. John's bread, some genuine rum, and alcohol. Generally tincture of catechu, decoction of oak bark and sugar-coloring (caramel) are added in proper proportions. The preparation of another "rum essence," which when mixed with alcohol, gives at once a product resembling rum without any other addition, is as follows: 75 parts of alcohol — 90° Tralles — 50 parts wood vinegar, 30 parts sulphuric acid, 20 parts manganese and 10 parts of potato starch, are distilled, and the resultant distillate colored with caramel.

Imitation and Artificial Rums.

1. "Ordinary rum." For 30 quarts — 80° Tralles: Rectified spirit, 90° Tralles, twenty-six and two-thirds quarts; best "rum essence," three-eighths quarts; vanilla essence, one-tenth ounce; water, 3 quarts; St. John's bread, one-half pound; raisins, one-half pound. Mix first the spirit, rum, and vanilla essence, then boil the St. John's bread and raisins in the 3 quarts water for one-half hour, allow the decoction to clear; filter; allow to cool, and now add the latter to the former, and color with caramel.

2. "Average rum." For 30 quarts — 70° Tralles: Rectified spirit, 90° Tralles, twenty-one and one-half quarts; good Jamaica rum, two and one-half quarts; rum essence, one-fourth quart; vanilla essence, one-tenth ounce; water, 6 quarts; St. John's bread, one-half pound; raisins, one-half pound. Prepared as above.

3. "Good rum." For 30 quarts — 70° Tralles: Rectified alcohol, 90° Tralles, 19 quarts; good Jamaica rum, 5 quarts; rum essence, 6 ounces; vanilla essence, one-tenth ounce; water, 6 quarts; St. John's bread, one-half pound; raisins, one-half pound. Prepared as above.

4. "Jamaica rum, common." For 30 quarts — 70° Tralles: Rectified spirit, 90° Tralles, 16 quarts; good Jamaica rum, 9 quarts; rum essence, 4 ounces; vanilla essence, one-tenth ounce; water, 5 quarts; St. John's bread, 5 ounces; raisins, 5 ounces. Prepared as above.

5. "Jamaica rum, average." For 30 quarts — 70° Tralles: Rectified spirit, 90° Tralles, 12 quarts; good Jamaica rum, 15 quarts; rum essence, 3 ounces; vanilla essence, one-tenth ounce; water, 3 quarts; St. John's bread, 4 ounces; raisins, 4 ounces. Prepared as above.

6. "Jamaica rum, good." For 30 quarts — 70° Tralles: Rectified spirit, 90° Tralles, 10 quarts; good Jamaica rum, 17 quarts; rum essence, two and one-half ounces; vanilla essence, one-tenth ounce;

water, 3 quarts; St. John's bread, 3 ounces; raisins, 3 ounces. Prepared as above.

7. "Jamaica rum, good." For 30 quarts—70° Tralles: Rectified spirit, 90° Tralles, 6 quarts; good Jamaica rum, 22 quarts; rum essence, one and one-half ounce; vanilla essence, one-tenth ounce; water, 2 quarts; St. John's bread, one and one-half ounce, raisins, one and one-half ounce. Prepared as above.

8. "Santa Cruz rum." To 35 gallons of New England rum add 5 gallons Santa Cruz rum and 1 drachm vanilla flavoring.

9. "Jamaica rum." 20 gallons spirits, 10 above proof; 20 gallons "New England rum," 10 above proof; one-half pound "Jamaica rum essence;" 1 gallon St. John's bread flavoring and 1 pound white glycerine. Color with caramel.

10. "Jamaica rum." 40 gallons spirit, 10 above proof; 1 pound Jamaica rum essence; 10 drops oil of cloves; 1 gallon St. John's bread flavoring; 1 pound white glycerine; and you may add 1 ounce gum kino, 1 drachm oil of caraway, each dissolved in 2 ounces 95° alcohol, and mix.

11. "Jamaica rum." To 45 gallons New England rnm add 5 gallons of "Jamaica rum", 2 ounces butyric ether, one-half ounce oil of caraway, cut with alcohol of 95 per cent Tralles, and color with sugar coloring.

12. Or, add to 36 gallons of pure spirit 1 gallon Jamaica rum, 3 ounces butyric ether, 3 ounces acetic ether, one-half gallon sugar syrup; mix the ethers, etc., thoroughly, and color with burnt sugar.

13. "Santa Cruz rum." To 50 gallons pure proof spirits add 5 gallons Santa Cruz rum, 5 pounds refined sugar in one-half gallon of water, 3 ounces butyric acid, 2 ounces acetic ether, and color if required.

14. Or, to 45 gallons New England rum add 5 gallons of Santa Cruz rum and 5 drachms vanilla essence.

15. "Rum." Five gallons of pure spirit; 5 pints of the rum you wish to imitate, and one-eighth ounce of oil of caraway seeds.

16. "Pineapple rum." To 50 gallons of rum, made by the fruit method, add 25 pineapples, sliced, and 8 pounds of white sugar; let it stand for 2 weeks before drawing it off.

17. "Jamaica rum" may be produced from the rectified spirit by employing 1 pound essence of rum; 1 ounce oil of pimento; 1 ounce tincture of orris root; one-half ounce Peruvian balsam. Dissolve the oils separately and then mix with them the essence, and throw them in a cask containing 160 gallons of pure spirit; or by the Jamaica rum flavorings, of which 1 gallon added to a barrel of pure spirits will produce an excellent rum.

18. "New England rum." This is generally prepared in the Eastern States by the distillation of molasses, but frequently this material is not so plentiful and resort is had to the common corn whiskey, which is once more rectified, and by adding 1 pound of strong essence of Jamaica rum and 1 pound of nitrous ether to 10 barrels of such purified corn spirits a good New England rum is obtained.

19. "Jamaica rum." Take to 40 gallons spirits, proof, one-half pound of the "rum essence," one-half pint of our sugar coloring and 1 quart sugar syrup.

"St. Croix rum," "Batavia Arrac," "New England rum," the same as above, without the coloring.

In Fresenius "Zeitschrift" Jahrgang III, page 232, Birchöl-tinctur

and shining soot-tincture (glanzrusstincture), are mentioned as additions to artificial rum.

A practical liquor manufacturer recommends, first to prepare the so-called "rum-body" (rumkörper), as follows: Digest 10 pounds catechu with 8 quarts 96° (Tralles) alcohol several days with occasional stirring, till the supernatant liquid has become dark brown and the sediment light brown. Now boil 40 pounds fresh St. John's bread and 10 pounds raisins with 20 quarts water for 25 minutes; strain through a bag, and press the residue properly out. To the liquid obtained add 8 quarts alcohol. Now mix the clear liquid of the catechu tincture with the latter thoroughly, allow to settle, and use for 600 quarts of alcohol from 2 to 3 quarts of this mixture; flavor with No. 1 A "Kingston rum-essence."

The substances used in the preparation of artificial rums require but a passing notice. The quantities in which they are used in these mixtures are but trifling as compared with the quantity of the product obtained. Moreover, none of them is, so far as I know, poisonous in the proper sense of the word.

The ethers employed in the preparation of artificial rums, whiskies and brandies, are mainly etherical compounds of organic fatty acids with the oxides of ethyl and amyl, some of which are also used in the preparation of the well-known artificial fruit essences, so much employed now in the household, by confectioners, etc., for flavoring pies, ice creams, jellies, fruit syrups (*so-called*), soda water, etc. The recognition of their presence depends mainly on their odor, or that of the fatty acids contained in them. Evaporate a portion of the liquor (from 1 to 2 ounces), after the addition of a little caustic alkali, over a water bath at a low temperature, almost to dryness, allow it to cool, and then on the addition of a few cubic centimeters of concentrated sulphuric acid, their characteristic odor will appear. Or we may distill them with an alcoholic solution of caustic alkali. When all the alcohol has passed over, we add diluted sulphuric acid, distill again, and obtain thus in the distillate the volatile fatty acids of the ethers.

When we suspect the presence of nitrous ethers (sweet spirits of nitre), in a liquor, which, as we have seen, is often used in the compounding of artificial liquors, and not found in the genuine one, we must distill a portion of the liquor. The nitrous acid and the nitrite of ethyl will be contained in the first portion of the distillate; we test the latter by adding some iodide of potassium solution, starch paste, and finally, acetic acid; a blue color indicates its presence. Or we evaporate another portion of the liquor, after the addition of potassa to a slight alkaline reaction, over the water bath almost to dryness, and test the residue for nitrite and nitrate together by strong sulphuric acid and solution of ferrous sulphate (Prescott).

Since now the aroma of the genuine liquor depends, as much as that of the spurious ones on ethers (produced in the former, as stated previously, by the action of the volatile fatty acids on the volatile alcohols during the time of keeping), it follows that except these ethers differ from those added to the artificial products, that the decision whether a liquor is genuine or artificial, cannot be properly and finally decided by an investigation of the ethers contained in the liquors,* especially

* Professor Prescott says in his book, page 59: "Artificial bouquets in wines and liquors may be so made and used as not to be distinguished from natural bouquet by chemical test."

since we do not even to-day know positively what different kind of ethers constitute the aroma in the various kinds of genuine brandies, whiskies and rums.

Analyses of Rum.

The results of my examination of 25 samples of rum are contained in the following table :

Results of the Examination of Rums.

State Inspectors' Number.	Color.	Two-thirds rum, one-third concentrated sulphuric acid mixed. When cool odor of rum.	Reaction.	Specific gravity by Pyknometer at Celsius.	Alcohol. Percentage by volume at 60° Fahr.	Alcohol. Percentage by weight.	Solid residue at 212° Fahr. per cent.	Ash per cent.
174.	Light brown	......	Acid	.9580at26°	37.00	30.74	0.0830	0.0010
175.	Amber	None	Very slightly acid	.9490 " 24.5°	40.40	33.78	0.1250	0.0110
176.	Light brown	Good	Acid	.9411 " 23°	45.60	38.49	0.3860	0.0100
177.	Light amber	None	Slightly acid	.9392 " 24.5°	46.20	39.06	1.2050	0.0030
178.	Light amber	Good	Slightly acid	.9402 " 24.5°	45.10	37.99	0.3920	0.0090
179.	Amber	None	Acid	.9452 " 21°	43.90	36.91	0.7700	0.0140
180.	Light amber	None	Very slightly acid	.9684 " 25°	26.40	21.66	0.2594	0.0105
181.	Amber	Good	Slightly acid	.9349 " 25°	44.90	37.80	0.4780	0.0080
182.	Light brown	Good	Slightly acid	.9414 " 23°	44.60	37.56	0.1354	0.0150
183.	Amber	......	Very slightly acid	.9348 " 25°	47.80	40.49	0.1700	0.0110
184.	Light brown	Good	Very slightly acid	.9564 " 22.5°	34.70	28.74	0.2840	0.0080
185.	Light brown	Very slight	Slightly acid	.9412 " 26°	45.00	37.90	1.0100	0.0070
186.	Light amber	None	Very slightly acid	.9658 " 22.5°	35.30	29.29	0.1110	0.0080
187.	Amber	Slight	Slightly acid	.9426 " 26.5°	43.80	36.82	0.2425	0.0750
188.	Light brown	None	Very slightly acid	.9638 " 25°	30 00	24.69	0.2030	0.0065
189.	Light brown	Good	Acid	.9498 " 25°	38.70	32.25	0.2920	0.0050
190.	Light amber	None	Neutral	.9473 " 24°	41.40	34.67	0.0650	0.0030
191.	Light brown	Very slight	Slightly acid	.9645 " 25°	31.80	26.24	0.4500	0.0050
192.	Almost colorless	Good	Slightly acid	.9344 " 19°	49.75	42.26	0.0845	0.0020
193.	Dark amber	Good	Slightly acid	.9409 " 24°	45.60	38.49	1.5100	0.0110
194.	Light amber	Slight	Slightly acid	.9428 " 23°	45.15	38.10	0.2160	0.0100
195.	Light brown	Slight	Slightly acid	.9316 " 23°	50.30	42.87	0.1300	0.0200
196.	Brown	Slight	Slightly acid	.9454 " 19°	44.40	37.39	0.5660	0.0010
197.	Amber	Very slight	Slightly acid	.9445 " 24°	42.70	35.83	0.0750	0.0040
198.	Light brown	Very good	Acid	.9126 " 25°	57.80	50.04	0.6560	0.0090

No reaction for sulphuric acid or soluble sulphates was obtained except in one sample, and here only to the extent of a trace.

In eleven samples slight traces of chlorine were detected, probably due to common salt.

Fehling's solution gave a decided reaction in eighteen samples, very slight in four, none in three.

The reaction for fusel oil was distinct in all cases.

The filtrate, after adding acetate of lead, was colored, except in two samples.

Albumen gave a heavy precipitate in six samples ; some in all the rest. The filtrate was colored in eighteen samples ; colorless in the rest.

A portion of each sample was evaporated to one-tenth, and tested as follows:

a. The taste was sweet in sixteen samples, bitter in two, and not noticeable in the rest.

b. The reaction was acid in twenty-three cases and neutral in two.

c. Ferric chloride gave a strong reaction for tannin in three cases, a slight reaction in twenty, and none in two.

d. Gelatine gave a reaction for tannin in all cases but two, strong in five, decided in fifteen, and very slight in three.

e. Fehling's solution indicated grape sugar strongly in fourteen cases; clearly in the remaining eleven.

Remarks on Analyses of Simple Liquors.

Before speaking of the compound liquors a few remarks on the results obtained in my investigation of simple liquors may find a proper place here.

Unquestionably the most important ingredient in all distilled liquors is the alcohol. The results obtained in my investigation of the 100 samples of liquors received from the State Inspector and recorded on tables "A," "B," "C" and "D," appended to this report, go to show, that there is a very great variation in the quantity of this ingredient in the various samples, and if 50 per cent of alcohol by volume or proof (Tralles) is the proper standard, then it follows, with only a few exceptions, almost all the above samples have been watered to a greater or less extent. Thence it is absolutely necessary for your Honorable Board to agree on some alcohol standard for these four kinds of liquors, below and above which, no liquor should be sold to the consumer in the State of New York, and its addition to be considered an adulteration.

Next of importance to the alcoholic strength of these liquors, are undoubtedly their aroma (flavor), and their taste. To appreciate them properly requires the nose and tongue of an expert, but how much they are appreciated by the public is readily seen by the price paid for some of their brands; and in fact as stated before, it is the aroma and the taste which regulate entirely their market value. The aroma as I have said previously (in genuine liquors), is due to the compound ethers formed during the ageing of the liquors by the action of the volatile acids on the volatile alcohols (the constitutents of the various fusel oils). The quantity present of these aromatic ethers in liquors, is sometimes remarkably small, one part in 40,000 parts, or 0.0025 per cent as stated by some authors. Even in the manufacture of artificial liquors, the manufacturers of the oil, essence, etc., employed for their preparation, recommend from one to sixteen ounces, or from 0.081 to 0.33 per cent of their respective preparations. Quantities as small as these are difficult to identify, except we have a sufficient amount of material at our disposal, since their identification depends mainly on the smell. Although the presence of fusel oil was indicated by the aniline test in most of the samples submitted to examination, in only a very few could its presence be perceived by the smell according to the usual method of rubbing the liquor between the hands, etc.

The Coloring Matter.

Naturally all distilled liquors are originally colorless, but gradually they extract from the wood of the oaken cask some coloring matter, tannin, etc., and thereby become, according to age, more or less amber colored. This process of coloring is of course a very slow one, hence the habit of the rectifier to add various coloring matters which enables him to send his products sooner into the market. In regard to the various materials used for this purpose, Prof. Prescott says on page seventy-five of his valuable book — "The coloring substances which are used as additions to alcoholic liquors, are indefinitely numerous........ In consequence of the great number of these foreign coloring materials, and the chemically indifferent character of both the natural and foreign color substances, as well as because of their small proportional quan-

tity, their chemical determination is generally difficult, and sometimes impracticable."

E. Carles recommends the addition of some albumen to the sample of liquor, the mixture to be well shaken, when (as he says) the genuine liquor, after proper settling, will become colorless, while the artificial will not. (Caramel will not be affected by albumen.)

Basic acetate of lead precipitates most coloring matter, yielding after filtration a colorless liquid, while the caramel coloring is not apparently affected, as far as color is concerned. Ferric chloride gives in genuine liquors, a blue black precipitate in consequence of the tannates present, but does not affect caramel.

A solution of gelatine does not affect caramel, but precipitates the tannin in genuine liquors.

The results of these tests, I have given in the above mentioned tables, and they go to show that only a few in each of those three classes of liquors are not colored artificially by caramel.

Acidity of Liquors.

Generally liquors are slightly acid, due to the volatile acids, especially acetic acid, which pass over during distillation, and which give rise to the ethers as stated previously. Sometimes acetic acid (vinegar) is added by the manufacturer or rectifier, to accomplish the same end (the troduction of acetic ether), during the ageing of the liquor. In none of the samples examined *could free sulphuric acid be* detected, nor anything more than a trace of combined sulphuric acid and chlorine.

Solid Residue and Ash

Require no comments, their percentage in the genuine being as large as in those we must consider by my tests sophisticated or artificial. The addition of sugar, usually in the shape of simple syrup, is now so universally practiced to cover up the harsh or rough taste of new liquors, and to give age that it may be almost considered legitimate to-day. I found in almost all of the samples, either grape or cane sugar, but have recorded only the former in my tables. (The liquor is heated almost to boiling for about fifteen minutes with some concentrated pure hydrochloric acid, after cooling neutralized with carbonate of soda, and tested in the usual way with Fehling's copper solution as given in Fresenius for sugar.)

No heavy metals like arsenic, copper, lead, zinc, etc., could be detected in any of them, they could of course be only due if present, to carelessness of the manufacturer or rectifier. The various samples of these liquors had after removal of the alcohol, no acid or decidedly bitter taste. Some were almost tasteless, others slightly sweet, and others sweet; a few astringent, or sweetish astringent, hence no grains of paradise, or other sharp spices had been used in their manufacture.

In how far, or if at all, in the production of these liquors, the additions of water, artificial ethers, acids, coloring matters, etc., may be allowed, and what kind, or which of these should be considered injurious to health or not, must of course be decided by your Honorable Board. I hope I have given due prominence in these reports on all those matters pertaining thereto.

Gin.

The most important of the compound liquors is the so-called "gin" or "Geneva" (Holland Schiedamschnapps) an alcoholic beverage, possessing the peculiar aroma of the juniper berry. The most renowned "Geneva" is manufactured in Holland, and exported from thence all over the world.

"Gin," or rather "Holland Gin" consists, like the other liquors previously spoken of, of alcohol and water, flavored with the oil of juniper (usually) or turpentine, or with both. It differs from the previously enumerated liquors in this, that in its manufacture a grain whiskey or spirit is redistilled with certain spices to give the peculiar aroma.

In Holland, the "Vaterland" of gin, it is usual to employ barley malt and rye meal in the preparation of the raw whiskey, and the latter is then after a proper rectification redistilled with some juniper-berries and occasionally with an addition of hops. In America it is more customary to take the oils in the proportion of about one fluid ounce of the oil of juniper to thirty-three gallons of spirit, or about one fluid ounce of turpentine to 10 gallons of spirit. Of other oils slight additions are made, of such as the oil of lemon, bitter almonds, caraway, cassia, cardamom and sweet fennel. Moreover, often some creosote, garlic and horseradish are added. These together with the required amount of water and some salt, are mixed together in the still, and then submitted to a redistillation. The objections to the use of creosote and oil of bitter almonds have been given previously. In England it is not unusual to use ordinary rectified grain spirit, together with a number of spices, etc., in the manufacture of the various brands of gin.

The following recipes have been taken from the "New Encyclopædia of Chemistry:"

	British Gin.	Cordial Gin.	Cordial Gin.	Fine Gin	Lond'n Gin.	West Cou'ry Gin.	G'ne'a.	Plain G'ne'a.	G'ne'a.
Juniper berries, German.	95 lbs..	70 lbs..	100 lbs.	96 lbs..	70 lbs..	14 lbs..	84 lbs.	84 lbs..	168 lbs.
Coriander seeds.........	95 lbs..	56 lbs..	70 lbs.	6 lbs..	70 lbs..	"	112 lbs.	84 lbs..	74 lbs.
Crushed almond cake....	46 lbs..	5 lbs..	"	"	3½ lbs.	"	6 lbs.	"	12 lbs.
Angelica root..........	2 lbs..	2½ lbs.	1 lb..	4 lbs..	1½ lbs.	"	4 lbs.	2 lbs..	8 lbs.
Licorice powder	6 lbs..	6 lbs..	"	"	6 lbs..	"	"	2 lbs..	"
Orris root, broken......	"	1½ lbs.	2 lbs.	2 lbs..	"	"	"	2 lbs..	"
Cardamom.......... ...	"	1½ lbs.	½ lb..	"	"	"	½ lb..	.....	1 lbs.
Calmus root....	"	"	2 lbs.	"	"	1½ lbs.	6 lbs.	2 lbs..	2 lbs.
Grains of Paradise	"	"	"	4 lbs..	"	"	"	"	8 lbs.
Orange peel......... ..	"	"	"	2 lbs..	"	"	"	"	"
Cassia buds	"	"	"	"	"	"	"	"	"
Sulphuric acid..	"	"	"	"	"	8 lbs..	"	"	"
Spirit	650 gal.	700 gal.	950 gal.	960 gal.	700 gal.	700 gal.	950 gal.	950 gal.	950 gal.

During the process of distillation, of course only the volatile portions of these ingredients (the volatile oils) pass over, and impart their peculiar aroma to the liquor. Among the substances above enumerated as being employed in the manufacture of gin is one, the use of which is not only very objectionable, but dangerous to health, namely the almond cake — obtained from bitter almonds — since prussic acid may be formed in the still and pass over into the distillate, the gin.

The following are all the analyses of gin, which I have been able to find recorded in the books at my disposal.

1. "Pure imported gin." Nearly colorless, acid reaction, sweet taste,

83

odor of juniper, alcohol 39.7 per cent by weight; acetic acid 0.0001 per cent; oil of juniper, cubeb and turpentine; solid residue 2.3 per cent containing sugar (0.9 per cent of the liquor) and potassium and sodium chlorides and nitrates (chlorine 0.0002 per cent). (See Amer. Chemist, August 1876, analysed by M. U. Green, Ph. D.)

2. Gin "Rip VanWinkle:" "The sample was colorless, containing 51 per cent of alcohol at 60 deg. Fahrenheit (by volume) and gave in one fluid ounce 3.25 grains of solid residue. Bouquet delicate and lasting. Quality fine." (Prof. J. Babcook in his second annual report as Inspector and Assayer of liquors of Mass., Boston, 1877, page 38".)

Prof. Babcock gives also the alcoholic strength of 155 samples of gin in his first and second State report as follows:

"Gin," 129 samples. Alcohol by volume from 33 to 50.6 per cent at 60° Fahrenheit; American gin, 8 samples. Alcohol by volume from 48 to 49.8 per cent at 60° Fahrenheit; "Holland gin," 12 samples. Alcohol by volume from 45 to 49.5 per cent at 60° Fahrenheit; "Rye gin," 5 samples. Alcohol by volume from 43 to 49 per cent. at 60° Fahrenheit; "Swan gin," 1 sample. Alcohol by volume from 47.5 per cent at 60° Fahrenheit.

H. Grouven (Dr. J. König, vol. II, page 469) found 47.8 per cent Alcohol by volume, 40.3° per cent by weight.

The analytical method to be followed in the examination of gins does not materially differ from that of the other liquors previously considered, hence I must refer to what I have stated there.

To decide the question, whether a gin under examination is flavored with oil of juniper or oil of turpentine, may be done by extracting the oils, with benzol, petroleum, naphtha or ether, etc., mixing with water, etc., and finally evaporating the solvent at a very low temperature. The characteristic odor of the spice or oil employed will appear in the residue. (The distillate, the residue, or both, when determining the alcohol may be employed advantageously for this purpose.) Moreover, oil of juniper differs from oil of turpentine in this, that the former does not form with hydrochloric acid a solid, but deflagrates with iodine, while oil of turpentine forms in the cold a solid with hydrochloric acid having an odor resembling that of camphor, and with iodine it turns green and detonates.

Since "gin" is a compound liquor its method of preparation (like that of all compound liquors) as well as the various ingredients used in its manufacture, are chosen by each distiller at will, hence we cannot speak of the adulteration of gin and other compound liquors as we do of that of wine, brandy or rum. Our main object in our analytical investigation must be therefore, to decide, if these liquors contain any thing objectionable to health.

The following recipes have been taken from various sources, and they show together with those given previously, the great variety existing in the manufacture of this liquor.

"London cordial gin." "To 90 gallons of good gin add 1 drachm of oil of sweet almond, 2 drachms of oil of cassia, 2 drachms of oil of nutmeg, 2 drachms of oil of lemon, 3 drachms of oil of juniper, 3 drachms of oil of caraway, 3 drachms of oil of coriander, 3 fluid ounces of essence of orris root, 3 fluid ounces of essence of cardamom, 3 pints of orange flower water, 56 to 60 pounds of lump sugar, dissolved in 4 gallons of pure water. Dissolve the oils and essences in 2 quarts of al-

cohol of 95° Tralles, and add the mixture gradually till the proper flavor is produced; then mix in the dissolved sugar and add sufficient soft water with 4 ounces of alum dissolved in it, to make up 100 gallons. When all is perfectly mixed, add 2 ounces of sal tartar dissolved in 2 to 3 quarts of hot water; then stir up all and mix the liquor well once more and allow it to repose. In a week it will have become brilliant and may be racked off."

"Schiedam Schnapps," imitation. "Take gentian root, one-fourth pound; orange peel, one-fourth pound; puds, one-half pound (but if this last cannot be obtained, poma aurantior, ripe oranges), or agaric, one-fourth pound; best galangal, one-fourth pound; contaury, one-fourth pound; put pure spirit, 10 gallons, upon them, and let them stand two weeks; stir it every day, and at the end of that time put 3 gallons of this to one barrel of good whisky, then bottle and label.

"Aromatic Schiedam Schnapps." To 25 gallons of good common gin 5 over proof, add 5 pints strained honey, 2 gallons clear water, 5 pints of white sugar syrup, 5 pints of spirit of nutmeg mixed with nitric ether, 5 pints of orange flower water, 7 quarts of pure water, 1 ounce of acetic ether, 8 drops oil of wintergreen dissolved in the ether. Mix all the ingredients well, and if necessary fine with alum and salt of tartar."

To reduce "Holland gin." "To 25 gallons of pure Holland gin add 25 gallons of pure French spirit, one-half gallon white sugar syrup, and mix thoroughly."

"American gin" without distillation. Take 1 gallon of proof spirit, 1 ounce of juniper berries, 10 drops of oil of turpentine, 5 drops of oil of sweet fennel; rub the oils together with a sufficient quantity of loaf sugar, then add one-eighth pint of rectified spirits of wine, and now mix it well with the proof spirit. The next day add one-half pint of clear lime water and fine with a bit of rock alum the size of a pea; strain, and when clear add 2 or 3 quarts of sweetened water to reduce it to the proper strength. Will produce 12 to 14 pints of American gin.

"Holland gin." "To 100 gallons rectified spirit, add one and one-half ounce of English juniper oil, one-half ounce of angelica essence, one-half ounce of oil of coriander, one-half ounce of caraway oil (the oils to be dissolved in 90° Tralles alcohol first); mix thoroughly. To make it up for the trade add 45 pounds of loaf sugar and 4 ounces of rock alum; mix again thoroughly and finally add for finings 4 ounces of sal tartar."

"Or, to 40 gallons of proof spirits add of sweet spirits of nitre 3 ounces, loaf sugar 4 pounds, oil of juniper 1 ounce, oil of caraway one-eighth ounce — the last two dissolved in a quart of alcohol previously. After mixing let stand for 24 hours.

To prepare "Holland gin," take two and one-half ounces of the best juniper oil, 20 drops of oil of lemon, 15 drops of oil of coriander. Dissolve the oils in 2 quarts of high proof alcohol and let it stand over night, then put them in a forty-gallon barrel of pure spirits, and add 1 gallon of syrup of gum arabic."

"London cordial gin" is prepared likewise from two and one-half ounces oil of juniper berries, 20 drops of oil of calamurs, 10 drops of oil of angelica, 5 drops of oil of coriander; dissolve the oils, in 2 quarts of 95 per cent alcohol Tralles and add it to 40 gallons of pure spirits, and finally add 2 gallons of syrup of gum arabic."

"Should the liquor be milky it is necessary to filter it, which is done

by letting it run through a woolen filtering bag in which is contained a mixture of 4 ounces of burnt alum, 6 ounces of white pipe clay, 4 ounces of carbonate of magnesia, one-half ounce dry pearl ashes." "This compound is suitable for all liquors which have become milky by the addition of any essential oil to weak spirits. It is always necessary to pour the filtered alcohol in small quantities into the barrel containing the pure spirits, and to shake the barrel every time a fresh portion of the same is added, then the gin will remain clear, otherwise it will become milky again and occasion much trouble and difficulty to filter forty gallons of gin through the bag." In order, however, to avoid the trouble of filtering the gin, flavoring may be employed for the purpose, and one gallon of the flavorings thrown into a barrel containing from forty to forty-five gallons of pure spirits will produce a clear gin, and answer all the requirements of Holland or English gin."

"Genèvre, for 30 quarts of 50° Tralles." "Juniper berries, 5 pounds; alcohol, 80° Tralles, 20 quarts; water, 10 quarts; distil off 20 quarts, add the necessary alcohol and water and one pound of sugar."

"Genèvre, for 30 quarts of 50° Tralles." "Oil of juniper, one and one-half ounce; sugar, 1 pound; alcohol, 90° Tralles, sixteen and two-thirds quarts, and the necessary water."

"Genèvre-Holland, for 30 quarts of 50° Tralles." Genèvre oil, one and one-fourth ounce; sugar, 1 pound; wine spirit essence, one-fourth ounce; St. John's bread, one-half pound; rectified spirit, sixteen and two-thirds quarts. The sugar and St. John's bread are boiled with water for one hour, then filtered, and finally mixed together with the rest, and the necessary water added."

"Another for thirty quarts of 50° Tralles." "Holland genèvre essence three ounces, sugar one pound; St. John's bread one-half pound, rectified spirts of 90° Tralles sixteen and two-thirds quarts; add the necessary water to bring it to 50° Tralles."

"Imitation of Schiedam Gin." "Dissolve three and one-half drachms oil of juniper in sufficient ninety-five per cent alcohol to make a clear liquid; add it to forty gallons French spirit, ten above proof, with eight ounces of orange flavoring (given previously) one quart syrup, and thirty drops oil of sweet fennel."

Imitation "Old Tom London Gin." "Dissolve in one quart ninety-five per cent (Tralles) alcohol, one drachm oil of coriander, one drachm oil of cedar, one-half drachm oil of sweet fennel, one-half drachm oil of bitter almonds, one-half drachm oil of angelica; add it to forty gallons French spirit ten above proof, with one pint of orange flower water, one quart syrup, and one drachm oil of juniper; dissolved in sufficient 95° alcohol (Tralles) to be clear."

The manufacturer of liquors, when he uses oil, etc., in their preparation, is often compelled to clarify or fine his products to make them clear, and thus acceptable to the trade, and for this purpose he usually employs alum and carbonate of soda or potash (sal tartar, pearl ash). I may therefore be permitted to quote here all of these recipes, even if I should repeat one or the other previously mentioned.

"To make spirit finings. Pulverize one pound ordinary crystals of alum, divide into twelve equal portions, and put up in blue papers marked number 'one'; next take six ounces carbonate (the ordinary sesquecarbonate) of soda, divide it into twelve parts and put them up into white papers marked number two. In place of the six ounces carbon-

ate of soda, four ounces dry salt of tartar may be substituted, but the white paper containing this latter substance must be kept in a dry, well corked bottle or jar."

"To clarify gin or cordials. To clarify from thirty to thirty-six gallons gin, dissolve the contents of one of the blue papers (as prepared in the previous recipe), in about one pint of warm water, and stir it into the liquor thoroughly. Then dissolve the contents of one of the white papers in about one-half pint hot water and stir well into the liquor, bung the cask close, and let the whole remain till the next day."

"To blanch gin or other white liquors. By using double the quantity of finings, that is, two of each of the powders as laid down in foregoing recipe, the liquor will be blanched as well as clarified. It is well to recollect, however, that the more finings are employed, the greater the risk of injuring the liquor, which may have a tendency to become flat when on draught."

"To remove the blackness from gin. Some gin has a peculiar blackness; to remove which, take one ounce pulverized chalk, and two or three ounces isinglass, dissolved; put this into the gin and it will become transparent. The above is enough for fifty gallons. The blackness which gin sometimes contracts by coming in contact with iron may also be carried down by putting a solution of two ounces isinglass and one quart skimmed milk into the spirits. When the color is very black, which will happen by merely an iron nail having fallen into the liquor, there is no remedy but to have the liquor distilled over again."

"To clarify stained gin. When gin has once become much stained, the only remedy is to redistill it; when it is only slightly stained, the addition of a few pounds acetic acid to a pipe or butt, one or two spoonfulls to a gallon, or a few drops to a decanter full, will usually decolor it. Dissolve two ounces of burnt alum in a little warm water, and add the solution to thirty quarts liquor, and shake thoroughly or draw several times a few quarts off and pour it back into the barrel. One-half ounce isinglass cut into small pieces, alcohol one and one-half ounces, water one pint. Soak the isinglass in the water and alcohol for several hours, then boil the mixture slowly till the isinglass is dissolved, and filter hot. Three ounces of this mixture is sufficient for thirty quarts liquor." To thirty quarts liquor or whiskey take the white of four eggs beaten to foam, and mix thoroughly. To thirty quarts liquor pour one pint sweet milk, mix, and in a few days it will be clear. Powder three-fourths ounces soda, one-fourth ounce burnt alum, and one-half ounce burnt lime, mix with water, let settle, and pour the clear liquid into thirty quarts liquor. Into one quart of wine vinegar and one quart of water stir the white of eight eggs; heat the mixture to 100° Fahr.; let it cool and fill the same in bottles for use if required. A very small quantity is sufficient, say one quart of the mixture to one barrel of any liquor which may have become turbid, to clarify it. Rub up half an ounce of burnt alum, half an ounce of prepared chalk and the white of two eggs in a pint of water."

"To clear and fine liquors. If after mixing the liquid it does not become clear, add from one to three ounces of pulverized burnt lime, and return the liquor to clean barrels. White wines fine with isinglass one and one-half ounces dissolved in one and one-half pints of water per hogshead. Red wines fine with the white of eggs, in the proportion of twelve to eighteen to each pipe; they must be well beaten to a

froth, with about one pint of water, and afterward mixed with a little wine before adding them to the wine; mix well."

Analysis of Gin.

The results of my investigations of the twenty-five samples of gin received are contained in the following table. The same remarks I have made in regard to the results obtained by my investigation of the previous seventy-five samples of liquors are also applicable here, hence there is no necessity to repeat them.

Results of the Examination of Gin.

State Inspector's Number.	Color.	Specific Gravity by Picknometer.	Alcohol. By vol. per cent.	Alcohol. By w'ht. per cent.	Solid residue at 212° Fahr. per cent.	Ash per cent.	Fusel Oil.
149.	Light yellow	0.9523 at 21° c.	37.28	30.90	0.018	0.002	None.
150.	Colorless	0.9624 at 22° c.	32.44	26.78	0.018	0.005	None.
151.	Colorless	0.9529 at 27° c.	37.70	31.34	0.048	0.005	None.
152.	Light yellow	0.9630 at 22° c.	32.14	26.53	0.772	0.001	Distinct.
153.	Light yellow	0.9592 at 25° 5 c.	31.09	25.64	0.027	0.008	None.
154.	Colorless	0.9522 at 18° c.	45.84	38.61	0.081	0.013	Trace.
155.	Light yellow	0.9634 at 24° c.	28.77	23.64	0.038	0.004	Trace.
156.	Light yellow	0.9609 at 21° c.	30.71	25.32	0.020	0.009	None.
157.	Light yellow	0.9456 at 25° c.	40.05	33.44	0.140	0.019	None.
158.	Colorless	0.9694 at 23° 5 c.	22.81	18.64	0.034	0.003	None.
159.	Colorless	0.9398 at 20° c.	39.70	33.15	0.069	0.002	None.
160.	Colorless	0.9560 at 26° c.	32.93	27.22	0.284	0.007	None.
161.	Light yellow	0.9408 at 25° c.	44.79	37.67	0.126	0.008	Trace.
162.	Light yellow	0.9507 at 27° c.	35.78	29.70	0.054	0.002	Trace.
163.	Colorless	0.9563 at 26° 5 c.	31.17	25.71	0.055	0.003	Trace.
164.	Light yellow	0.9584 at 21° 5 c.	33.20	27.44	0.044	0.013	Trace.
165.	Colorless	0.9406 at 22° c.	46.43	39.19	0.325	0.001	Distinct.
166.	Light yellow	0.9634 at 24° c.	28.78	23.64	0.034	0.006	None.
167.	Light yellow	0.9477 at 22° c.	39.42	33.13	0.044	0.012	Present.
168.	Light yellow	0.9564 at 24° c.	33.73	27.84	0.054	0.003	None.
169.	Light yellow	0.9448 at 22° c.	38.71	32.28	0.037	0.007	None.
170.	Colorless	0.9446 at 23° c.	40.76	34.04	0.037	0.004	None.
171.	Colorless	0.9556 at 21° c.	35.03	29.04	0.123	0.012	None.
172.	Colorless	0.9538 at 23° 5 c.	33.45	27.64	0.020	0.001	Trace.
173.	Colorless	0.9302 at 25° 5 c.	51.90	44.33	0.057	0.007	Distinct.

Reaction; four samples gave a decidedly and four a slightly acid reaction; the rest were neutral.

Chlorine was indicated in very small quantities in six samples, due probably to the presence of a little common salt.

Free sulphuric acid, as well as *soluble sulphates*, entirely absent from all the samples.

Sugar was detected in Nos. 152, 157, 160, 163, 165, 168, and 173.

The heavy metals were not detected in any of the samples.

Liquors.

In regard to other compound liquors, double spirits, liquors, cordial, absynths, stomach bitters and essences, crêmes, ratafias, punch extracts and essences, aromatic alcohols and waters used in their preparation, I can only speak here in general.

Many of them are prepared either by distillation of aromatic flowers, leaves, herbs, barks, seeds, fruits, peels, roots, raisins and essential oils; together with wines, ethers, aromatic essence and waters, etc., with rectified spirit and water, or by mixing the essential oils of these aromatics, and the other previously mentioned substances with the necessary rectified spirit, water, sugar syrup, etc., and coloring matter. The mixing

is done either cold or warm, viz., the sugar solution is added to the spirit and etherial oils, etc., either warm or cold. The same is done often when mixing the aromatic distillate with the necessary sugar solution. A warm mixing (which should always be done in a barrel, to prevent too much loss of alcohol) is preferable, since the liquor clears sooner and and is of better consistency. When the liquors are prepared by the cold method, the oils and essences must first be dissolved in some strong spirit, 90° Tralles, before they can be added to the spirit. The coloring in both cases is done after the perfect mixing of all other ingredients.

The names and numbers of these aromatic liquors are too many to give them in this connection, but I may be permitted to give a few more facts in regard to them. A single recipe-book before me, contains 521 recipes. In their preparation over 100 different ingredients are used, among which we find:

Anise-seed, angelica root, ambra essence, elecampane, aloes, oil of anis, ananas ether, ananas essence, oil of angelica, apricots, sulphuric ether, oil of elecampane, oil of wormwood, alum, seeds of angelica, bitter almonds, oil of bergamot, essence of bergamot, marsh clover, oil of bitter almonds, oil of valerian, huckleberry juice, boone-kamp essence, coriander, cardamom, cassia wood, oil of lemons, essence of lemons, sweet flag, blessed thistle, columba root, oil of cardamon, coca beans, oil of coriander, oil of sweet-flag, oil of cubebs, quinine bitter essence, cassia vera, gentian root, poly poddy, strawberries, fennel seed, figs, oil fennel, catarrh root, genevre oil, essence of raspberry, oil of hops, raspberries, raspberry ether, raspberry juice, Hoffman's anadine, Spanish hop leaves, ginger, oil of ginger, Jamaica rum, St. John's bread, caraway seeds, cherry pits, chamomile German, chamomile Roman, oil of chamomile, oil of caraway seeds, cherry juice, coffee, peppermint, oil of peppermint, laurel berries, oil of bay, lavender flowers, oil of lavender, Canadian agaric (Boletus laricis), mace, nutmeg, muscat wine, lemon balm, sweet marjoram, oil of mace, oil of balm, oil of marjoram, cloves, oil of cloves, nuts, orange flower water, orange flowers, oil of orange flowers, oil of origanum,bitter oranges, bitter orange peels, wild carrot, grains of paradise, root of pimpernel, Peruvian balsam, oil of parsley, oil of wild carrot, peach ether, quassia-wood, leaves of rosemary, rose leaves, oil of rose, oil of rosemary, rhubarb, starnis, sage, liquorice-wood, celery seeds, sassafras, saffron, oil of staranis, oil of sage, oil of celery, oil of sassafras, oil of sandal, thyme, oil of thyme, tea, centaury, tormentil (root), large valerian, orris root, vanille and tincture, essence of violet flowers, juniper-berries, wormwood flowers, oil of juniper-berries, white wine, roman wormwood, hyssop, Ceylon cinnamon, cassia barks, cassia buds, zedoray root, oil of cinnamon, oil of cinnamon leaves, oil of cinnamon flowers, sugar coloring, etc.

Since almost invariably these liquors are colored, often blue, green, red, etc., it is but proper that I should give their preparation from the same source.

Blue colors — Indigo color.

One and one-half ounce finely powdered indigo mix in a three quart stone jar with six ounces of sulphuric acid of 66° Beaumé, let stand at a moderate temperature several days then add under constant stirring one pint of pure water.

Violet-blue color. One and one-half ounces cochineal; digest with 10

quarts alcohol, 85° Tralles, from four to five days, then add 1-4 ounce burnt alum, filter and finally add 1-2 ounce ammonia.

Yellow colors — Saffron color. Saffron, 1 ounce; rectified spirits, 86° Tralles, 1 quart; macerate eight days and then pour off the clear liquor and filter.

Another saffron color. Saffron, 1 ounce; rectified spirit, 85° Tralles, 1 pint; water, 1 pint; macerate fourteen days, pour off the clear liquor and filter.

Curcuma color. Digest during eight days 1 pound coarsely powdered curcuma root with 1 quart alcohol of 85° Tralles, and then pour off the clear liquor.

Yellow color. One-half pound ginger, macerate for eight days with 1 quart of alcohol of 85° Tralles, and then pour off the clear liquid.

Green colors. Mixing the ginger, curcuma or saffron colors with the indigo color gives fine green colors; or, dissolve in warm water, curcuma, 2 ounces, wash-blue (Prussian blue?), 4 ounces, burnt alum 1 ounce, let the mixture stand four or five days, then pour off the clear liquid; or, take 3 pounds fresh grass and macerate it fourteen days with 1 quart rectified alcohol of 90° Tralles, then press and filter — a better color may be obtained when, in place of grass, dried nettles are employed, without injuring the taste.

Red colors—Brazil-wood color. Brazil-wood, one-quarter pound; burnt alum, 1 ounce; cream tartar, 1 ounce and boiled with 1 quart water one-half hour, after cooling the mass is pressed out, the liquid filtered and some alcohol added.

Saunders-wood color. Digest for eight days 3 ounces red saunders-wood with 1 quart rectified alcohol of 85° Tralles, press and filter; or 1 pound huckleberries, digest for eight days with 1 quart alcohol of 85° Tralles, press and filter; gives a more violet than red color.

Cochineal color. Cochineal, 1 ounce; burnt alum, 3-8 ounce, boil with one pint of water; after cooling pour off the clear liquid, filter and add some alcohol.

Another cochineal color. Cochineal, 1 ounce; sal tartari, 1 ounce; burnt alum, 1 ounce; rectified spirit, 85° Tralles, 1 quart, digest eight days and filter.

LITERATURE OF LIQUORS.

1. Anstie, Dr. Francis E.: Stimulants and Narcotics, their mutual relations with special researches on the action of Alcohol, ether and chloroform on the vital organism. London, 1864.

2. Balling, C. J. N.: Die Branntweinbrennerei und die Hefenerzeüg-ung. Prag.

3. Bartling, H.: Die Englische Spiritus fabrication, und der Spiritus auf dem Englischen Markte, etc. London, 1876.

4. Benecke: Die Conditorei und Liqueur fabrication auf Kaltem Wege.

5. Böhm, Heinrich: Branntweinbrennereikunde. Achte Auflage.

6. Bolley Handbuch: Der technish-chemcischen Untersuchungen, etc.

5. Auflage von Dr. Carl Stahlschmidt: Leipzig, 1879.

7. Chase, Dr.: Recipes or information for every body, an invaluable collection of about 800 practical recipes, etc. Ann Arbor, Mich., 1881.

8. Dick, William B.: Encyclopedia of practical recipes and processes. New York, 1880.

9. Dietzsch, Oskar: Anleitung zur Untersuchung der Lebensmittel und Getrânke. Zürich.
10. Duplais, P.: Traité de la fabricationdes liqueurs et de la destillation des Alcools. 4me edition. Paris, 1877.
11. Edis, Prof. Robert T.: Harvard medical school, "Alcohol as an article of diet."
12. Elsner, F.: Die Praxis des Nahrungsmittel-chemikers. Leipzig, 1880.
13. Encyclopædia: Lippincott's new, of Chemistry, or Chemistry, theoretical, practical and analytical, as applied to arts and manufactures, Philadelphia.
14. Flügge, Dr. C.: Lehrbuch der Hygienischen Untersuchungsmethoden. Leipzig.
15. Gaber: Die Liqueurfabrication. Vollständige Anleitung zur Herstellung aller Gattungen Liqueure, Crêmes, etc. Wien, Pest und Leipzig.
16. Geiss, Dr. F. G.: Die comprimirten Grundessenzen, oder wesentliche Verbesserung der gesammten Liqueurbereitung. Halle.
17. Gerlach, G. Th.: Ein gegenseitiger Vergleich der allgemeinen Areometer Scalen 1865.
18. Gumbinner, L.: Handbuch der Liqueurfabrication. Berlin.
19. Gumbinner, L.: Katechismus der Spiritusfabrication. Wien.
20. Gumbinner, L.: Practischer Wegweisser zur spiritusfabrication. Leipzig.
21. Haensel, H.: Die Branntwein und Liqueurfabrication, etc. Pirna, 1867.
22. Hamilton: Brennerei Erfahrungen, etc.. Leipzig.
23. Hamilton: Wichtige Brennereiberichte, für 1875–76. Zweite Auflage. Leipzig.
24. Hehner, Otto: Alkoholtafeln. Wiesbaden, 1881.
25. Hoffmann, Dr. A. W.: Bericht über die Entwickelung der chemischen Industrie, während des letzten Jahrzehends. Braunschweig, 1877.
26. Horatius, Dr. Th.: Die Fabrication der Aether und Grundessensen, etc., nebst einem Anhange: Ueber die Zusammensetzung von Liquuren Branntweinen, Rum, Arac, Cognac und verschiedenen Weinen. Wien.
27. Huss: Der gesammte Brennereibetrieb. Leipzig.
28. Johnson, Watson: Secret Wealth, comprising a collection of over 1500 rare and practical recipes, etc. Syracuse, 1875.
29. Johnson, James F. W.: Chemistry of common life, new edition. New York, 1880.
30. Juds: Practische Anleitung zur Liqueur-und Branntweinfabrication, so wie zur Wein und Mostbereitung und Verbesserung von getränken. Luzern.
31. Klenke, Dr. Hermann: Illustrirtes Lexicon der Verfälschungen der Nahrungsmittel und Getränke. Leipzig. 1878.
32. König, Dr. J.: Chemie der menschlichen Nahrungs-und Genussmittel. Zweiter Theil.
33. Koerte, A.: Die Branntweinbennerei nach practischen Erfahrungen wissenschaftlich erläutert, etc. Dritte Auflage, 1876.
34. Kraus: Ausführliche Anleitung zur Fabrication sämmtlicher Branntweine und Liqueure, etc. Mainz.
35. Kupfer, A. Th.: v. Handbuch der Alkoholometrie, Berlin.
36. Lintner, Prof. C.: und Gigl, die Rübenbrennerei in Ungarn. Munchen

37. Liqueur.: Recepte oder Anleitung die beliebten Liqueure auf kaltem Wege zu bereiten.

38. Lehmann: enthüllte Geheimnisse auf Kaltem Wege jede Art Liqueur darzustellen.

39. Loeff, Paul.: Practisches Handbuch für Brennereianlagen nebst darzu gehörigen Entwürfen, etc. Leipzig.

40. Märcker, Max.: Die chemischen Vorgänge bei der Spiritusbrennerei. Berlin, 1876.

41. Märcker, Max.: Handbuch der Spiritusfabrication. Zweite Auflage, 1880.

42. Merkel, W.: Sammlung von saccharometrischen Tabellen zur rationellen Anwendung des Densisaccharometers in der Brennerei und Brauerei. Leipzig.

43. Meyer und Finkelnburg: Gesetze befreffend den Verkehr mit Nahrungsmitteln, Genussmitteln und Gebrauchsgegenständen vom 14. Mai, 1879. Berlin, 1880.

44. Moewes, A. L.: Die Destillirkunst der geistigen Getränke auf warmem und auf kaltem Wege, etc. Siebente Auflage.

45. Murjahn, Edward: Schule der Brennerei. 3. Auflage von H. Badke.

46. Muspratt, Dr. S.: Chemistry, theoretical, practical and analytical, as applied to the arts and manufactures. Boston.

47. Nowak, Dr. Josef.: Lehrbuch der Hygiene. Wien, 1881.

48. Otto Birnbaum.: Lehrbuch der rationellen Praxis der Landwirthschaftlichen Gewerbe. Zweiter Theil, die Branntweinbrennerei, etc., von Dr. Stammer. Siebente Auflage.

49. Tayen, A.: Vollständiges Handbuch der Branntweinbrennerei und der Spiritusfabrication aus den hauptsächlichsten Stoffen, etc., deutsch von G. Turk.

50. Tiax, Antonio del.: Die Verwerthung der Weinrückstände, etc., zu Tresterbranntwein, Weinspirit, Oenanthäther, etc., mit einem Anhange; die Erzeugung von Weinspirit und Cognac aus Wein. Wien, Pest und Leipzig.

51. Prescott, Dr. Albert B.: Chemical examination of alcoholic liquors, etc. New York 1875.

52. Rion, A.: Sämmtliche Geheimnisse der Bierbrauerei, etc. New York, 1870.

53. Rosenthal, J.: Bier und Branntwein und ihre Bedeutung für die Volksgesundheit. Berlin, 1881.

54. Savalle, D.: Appareil et procedes nouveaux de destillation. Paris, 1876.

55. Schedel's Destillirkunst, von N.: Graedor bearbeitete. Siebente Auflage.

56. Schnacke, Dr. G. E. Alex.: Wörterbuch der Prüfungen verfälschter, verunreinigter und immitirter Waaren, etc. Gera in Reuss.

57. Schönberg, Aloys.: Der chemisch-technische Brennereileiter. Zweite Auflage. Wien.

58. Spiritus industrie: Die, deutsche im Jahre 1877. Berlin, 1878.

59. Schubert, Ed.: Practisches Recept. Taschenbuch, Dritte Auflage von Dr. H. Brokhurst. Braunschweig.

60. Schwarzwäller, Udo: Lehrbuch der Spirtusfabrication. Vierte Auflage. Leipzig, 1874.

61. Schwarzwäller, Udo.: Neueste Verbesserungen im Betriebe der Branntweinbrennerei. Leipzig.
62. Schwarzwäller, Udo.: Schule der practischen Spiritusbrennerei. Leipzig.
63. Siemens, K.: Mittheilungen über die eingeführten eigenthümlichen Neuerungen in der Brennerei, Brauerei und Stärkefabrication in Hohenheim, Braunschweig, 1870.
64. Smith, Dr. Edward.: Foods. (International Science series.) New York, 1874.
65. Stahlschmidt, C.: Die Gährungschemie umfassend Weinbereitung Bierbrauerei und Spiritusfabrication. Berlin, 1868.
66. Thiel, Carl Eugen.: Nahrungs und Genussmittel als Erzeugnisse der Industrie. Separat abdruck aus dem amtlichen Berichte über Wiener Weltaustellung, 1873. Braunschweig, 1874.
67. Stammer, K. und M. Delbrück: Brennereikalender.
68. Stellmacher: Practisch erprobte Original Recepte der Grundessenz, Rum, Punschessenz, Liqueur, etc. Zweite Auflage Leipzig.
69. Stohmann, F.: Encyclopaedisches Handbuch der technischen Chemie. Braunschweig.
70. Feuchtwanger, Dr. Lewis.: Fermented Liquors, a treatise on brewing, distilling and rectifying of Wines, Spirits, Cordials, Vinegars, etc. 5th edition New York, 1867.
71. Volcker, Prof. A.: Beet root distillation. Paris and London, 1879.
72. Wagner. Dr. Rudoff.: Handbook of chemical technology, translated by W. Crooks, F. R. S. 1872.
73. Wagner: Anleitung zur Erlernung der Liqueur fabrication.
74. Wassmus. G.: Kartoffelspiritusfabrication ohne Anwendung von Malz und Malzhefe, etc. Berlin, 1880.
75. Young's great book of secrets, 1878.

Besides the foregoing lists, the following will be found to contain valuable articles relating to this subject. Am. Chem.; Ann. Chem. and Phar.; Pap. Sci. Ms.; Arch. Pharm.; Ber. Ver. nat. Ver. R.; Ber. d. ch. Ges.; Bull. Soc. Ind. Paris; Chem. Centr.; Comp. Rend.; Dingl. Pol. J.; Elsner, Ch. Tech. Mitt.; Fres. Zeit.; Ind. Blätt.; Jahr. aq. ch.; Jahr. ch. Tech.; Jahr. F. Ch.; Jour. Ph. et Chim.; Jour. Prakt. Chem.; Monat. äff. Ges.; Jahr. f. Pharm.; Rep. f. Pharm.; Report, Inspect. of Liquors, Mass.; Nahrungsfäl., Han.; Pharm. Centr.; Pharm. Jour. Pogg. Anal.; Polyt. Notiz.; Sch. Wochb. Phar.; V. f. pr. Pharm.; Zeit. f. d. sp. fab.; Zeit. Phar. Russ.; Zeit. f. sp. Ind.; Zeit. Oest. Ung. Sp. Wien.

III. Malt Liquors.

Under the name "Beers," in the widest acceptation of the word, are included beverages which are produced by vinous fermentation, and which usually are still in a state of slow after-fermentation. They differ from distilled liquors, especially in their larger amount of solid matter remaining after the removal of water and alcohol. This residue consists of sugar, dextrine, albuminoids, phosphoric acid, potash, etc.

If we accept this definition of "beers," it follows that they may be made from any saccharine or starch-containing material; thus opening the door for the unscrupulous manufacturer to use all kinds of adulterations, substitutes, etc. Hence it is absolutely necessary to define

"beers" as the Bavarian government has done, namely: as wine-like liquids, yet in a state of after-fermentation *prepared only of barley malt, hops, yeast, and water.* To this might be added the lowest amount of malt and hops to be employed by the brewers in the manufacture of a barrel of beer of 32 gallons, and also the age the beer should have attained before it reaches the consumer.

All similar beverages produced by the use or substitution of various other materials for malt and hops, must be sold under names indicating the substitutes employed, as "rice beer," "wheat beer," "corn beer," "glucose beer," etc. Thus all fraud would be prevented, a more uniform product obtained and a wholesome beverage be insured.

The main constituents of normal beer may conveniently be divided into three classes:

1. The volatile constituents, carbonic acid, water, alcohol, acetic acid, etc.

2. The extract forming constituents, sugar, dextrin, albuminoids, glycerine, lactic and succinic acids, organic extractive matters from hops, hop resin, hop bitters, lupulin, etc.

3. The mineral constituents, the ash, phosphoric acid, potash, soda, silica, etc.

The present almost innumerable varieties of beer are distinguished by the trade and the consumer from each other:

First, by the material used in their preparation — barley malt, wheat, rice, rye, oats, corn, potatoes, grape sugar glucose, beet sugar molasses, cane sugar molasses, etc.

Second, by their alcohol and extract strength— ale, porter, stout, bock, doppel, lager, present use beers, "Braunschweiger Mumme," etc.

Third, by their color, due to the degree of heat to which the malt is subjected during the drying, or to the addition of beer color, caramel, molasses, etc.— dark, brown, amber, light yellow beers.

Fourth, by the method of fermentation employed, either superficial "Obergährung" (ale, porter, stout, etc.), or sedimentary, "Untergährung" (lager beers, etc.).

Fifth, by the degree of acidity (lactic and acetic acids) or sweetness, — Belgian "lambick, etc. And *finally* by the name of the country, locality, or individual manufacturer. "Scotch ale," "Bohemian and Bavarian" lager biers, Wiener, Munchner, Erlanger lager biers, London and Philadelphia porters, Zacherl's Doppelbier, Salvatorbier, etc. A few historical remarks on our now almost national beverage may find their proper place here.

The art of brewing is undoubtedly one of the oldest on record, and probably is due to the inventive genius of the ancient Egyptians; since we are told by Diodorus of Sicily (30 B. C.), that the Egyptian King Osiris, as early as 1960 B. C., introduced a beverage into his kingdom made from malt and fermented grain; and Herodotus (450 B. C.), speaks of beer as a common drink among the Egyptians, who called it wine of Pelusium, at which city a very highly esteemed beer was produced. Xenophon (400 B. C.), refers also to a fermented beverage from barley. Archilogus (720 B. C.), Aeschylus and Sophocles (400 B C.), and Theophrastus (370 B. C.), speak of a barley wine *vinum hordeaceum;* while Aristotle, Strabo, and others, refer to it under the name of *zythos.*

From the Egyptians the Greeks acquired the art of beer-making, and

from these again other nations in Europe. Plinius (80 A. D.), speaks of a beer produced in Spain, and called celia or ceria, while the ancient Gauls called it cerevisia. According to Tacitus (Cornelii Taciti de moribus germaniae. "Potus humor exhordeo aut frumento in quandam similitudinem vini corruptus.") The ancient Germans prepared a beverage from barley and wheat.

According to old German guild books, Gambrinus, king of Flanders and Braband (1200 B. C.), was the inventor of beer, and the German brewers of to-day hold him in high esteem. Eumens (A. D. 296) says: "Britain produces such abundance of corn that it was sufficient to supply not only bread, but a liquor comparable with wine." The use of beer had become so general in Britain in the seventh century, that Ina, king of Wessex, levied a tax to be paid on ale. In Nunrnberg, in 1299, the price for brown beer was regulated by a tax, and in Breslau in 1301, the malting and brewing were independent trades.

Grässe doubts the use of hops at the time of Charlemagne, though in a deed or gift executed by his father Pepin, in 768, there is mention made of a hop-yard, and in a document from the year 822, the miller of the chapter Corvey was dispensed by the abbot, from the labors in the hop-yard.

The oldest work on brewing is in Latin written in the year 1585. "De cerevisia ejusque conficiendi ratione, natura, viribus et facultatibus." Written by Thaddeus Hagecius ab Hayk, who, on 50 pages describes the methods of beer brewing, according to the common practice then in use. "In 1761 was published the first edition of Michael Combrune's "Theory and Practice of Brewing," the first work that attempted to treat of this industry on scientific principles."

The Brewing of Beer

Comprises the following four main operations:

1. The malting of the barley, and the grinding or crushing of the malt.
2. The mashing of the malt, the boiling, hopping, and cooling of the wort — properly called brewing.
3. The fermentation of the beer-wort.
4. The fining, ripening and preservation of the beer.

1. *The Malting of the Barley.*

This comprises:

First. The steeping of the barley in water till it has taken up about 50 per cent of this liquid, when it is washed several times to remove any slimy matter that may have been formed.

Second. The germination of the steeped barley, on proper floors in specially constructed buildings, in heaps, etc., when sufficiently advanced, is checked by the maltster by making the heaps thinner, and turning the grain several times during the day, till sufficiently dry for the kiln or drying cylinder. The time required for germination on the floors, is from eight to eighteen days, according to the temperature maintained in the heap and room.

Third. The drying or roasting. This is done in various ways, in kilns, cylinders, with hot air, steam, etc. At first the temperature must be very low, and gradually increased in the proportion as the malt loses

moisture. The higher the temperature rises during the drying and roasting of the grain, the darker the resultant malt and beer Malt is therefore distinguished as pale, amber, brown and black malt.

The main change going on in the barley during the process of malting, is the formation of a ferment from the gluten (protein) which in the mashing process acts on the starch, changing the latter mainly into malt-sugar, maltose, and dextrines. This ferment is called "diastase." Moreover another ferment, "peptase," is formed, whereby during the same process, peptones and parapeptones are produced from the gluten or protein. The roasted malt crushed between rollers or otherwise, is now ready for the mash tub.

The importance of producing a first-class malt cannot be over-estimated, since on its quality the quality of the beer mainly depends. Hence the selection of the grain, the time of steeping, the proper moment for stopping germination, the temperature to be maintained in drying, and roasting, etc., are all of the utmost importance in the production of a good malt, but the most important item in its production is the water used in steeping and washing, since bad water must undoubtedly produce bad malt, and also bad beer. Hence brewers should never overlook this matter, but should secure for their breweries the purest water obtainable. It should be free from *organic matter*, especially such as may be due to infiltration from sewers, vaults, cesspools, etc.

2. *The Mashing of the Malt, etc.*

There are several methods employed, but the two most important ones are the infusion and decoction methods, which it would be out of place here to describe. Suffice it therefore to state that they mainly consist in a digestion and extraction of the malt with hot water, during which process the starch is mainly changed into maltose sugar and dextrine, etc., and thus becomes soluble in the hot water. When the saccharification of the starch has been accomplished, the resultant wort is drawn off, and put into suitable vessels for concentration. Hops are then added, the tannin of which removes a portion of the albuminous substance during boiling. The boiling wort extracts from the hops not only the tannin, which thus assists very materially in the clearing of the wort, but also the bitter principle, the aroma, the resin, etc.; and on these mainly depend the peculiar, pleasant, bitter taste and the fine flavor of a good beer. Preserving qualities are also imparted to the wort from the hops. The degree of concentration of the wort depends — like the quantity of malt and hops taken — on the kind of beer the brewer wishes to make. From 8 to 25 per cent of extract in the wort are, under ordinary circumstances, about the limits.

The cooling of the wort is done in various ways; but it is of the utmost importance to cool as rapidly as possible to prevent lactic fermentation.

3. *The Fermentation of the Wort.*

After reducing the wort to the proper temperature it is transferred into the fermenting tubs, the required quantity of yeast added, and allowed to ferment. This fermentation may be of two kinds, as stated previously, surface or superficial fermentation, and sedimentary fermentation. Surface fermentation is more violent, of shorter duration, and takes place at a higher temperature than sedimentary fer-

mentation. The main change taking place in the wort during fermention is the formation of alcohol and carbonic acid by the decomposition of the sugar. When this first fermentation is over, the new beer is usually put in large casks, placed in a cool cellar, where the so-called after fermentation takes place, which, according to the temperature and the amount of sugar still present in the beer, etc., may last for a long time, as in the case of lager beers.

The process of fermentation of the beer-wort, requires as much attention as all the other previously enumerated manipulations in the brewing of a good beer; in fact, from the moment the barley and the hops enter the brewery, till the beer made of them goes to the consumer, the utmost attention has to be paid by the brewer at each succeeding age in its manufacture.

Methods of Analysis of Beer.

The analysis of beer comprises:

1. The proper observation of the physical qualities of the beer under examination.

2. The determination of its main constituents, carbonic acid, alcohol, total extract, sugar dextrine, nitrogenous matter, organic acids, glycerine, ash, phosphoric acid, potash, etc.; and,

3. The examination for adulterants.

The physical characteristics of beer, such as clearness, color, aroma, taste, brilliancy, viscosity, etc., must be carefully noticed. If the beer is not clear, it should be filtered previously before commencing the analysis. An examination of the residue left on the filter under a good microscope usually will reveal the cause.

Since these physical qualities of the various kinds of beer (the present use beer, lager, bock, ale, porter, lambic, etc.,) are dependent almost entirely on the peculiar methods of brewing, on the quality, quantity and kinds of raw material employed, on the kind of fermentation to which subjected, on the treatment in the cellar or during storing after manufacture, and on the age when brought into the hands of the consumers, etc., it becomes very difficult to give a proper norm for these different varieties of beer.

1. The determination of carbonic acid: —

This determination is of but secondary importance especially in this country, where, as is well known, almost every brewer uses a small piece of compressed bicarbonate of soda (from two-thirds to one ounce) for each small cask of beer (lager and present use beer) sent out; for the double purpose of neutralizing some of the acid in the beer, and to increase its quantity of carbonic acid gas.

The determination may be made in various ways. I prefer that of taking in a proper flask, about 200 grams (cubic centimetres) of beer previously cooled to 4° to 6° centigrade, to prevent as much as possible a loss of gas, connecting the flask in the usual way with a wash-bottle containing pure concentrated sulphuric, and this wash-bottle with a tube containing molten calcium chloride to retain all moisture which may pass over from the heated beer: I connect with the latter a Liebig's potash-bulb properly filled with caustic potash solution and acurately weighed, and finally with this apparatus a U tube filled with pieces of caustic potash and also weighed. To enable me to draw air free of carbonic acid through the entire apparatus after the expulsion of the carbonic acid from the flask containing the beer, by heating it over a water-bath, it is

provided with another tube, one end of which reaches below the beer and is open, while the other end, passing through the cork, is bent at right angles about an inch above the latter and closed by a finely drawn-out point. A piece of tightly-fitting rubber tubing is drawn over the latter and connected with a second Liebig's potash-bulb (properly filled with caustic alkali). As soon as the evolution of carbonic acid gas has ceased from the heated flask containing the beer, I break the fine point of the tube in the rubber tubing and draw the necessary air over with proper precaution to pass through the entire apparatus. The increase in weight of the first Liebig's potash-bulb and the U tube gives the percentage of carbonic acid if one hundred grams were used.

2. The determination of the specific gravity.

This is done in the usual way, at 15° Celsius, after removal of all carbonic acid, either by shaking the beer in a large flask, gently heating it, or pouring it from one vessel to another. The test is performed as previously explained.

3. The determination of alcohol.

The method of distillation, as previously explained, is the best. About one hundred grams of beer free of carbonic acid are put into a proper retort together with a few grams of tannin to prevent foaming, and some caustic baryta water to neutralize volatile acid present (thus preventing the air passing over into the distillate), and the distillation carried on till about two-thirds of the liquid has passed over. By now mixing the distillate with enough water (distilled) to make up the exact one hundred grams weight of the original beer taken, and taking the specific gravity of this mixture exactly at 15° Celsius, we find, by consulting Fowne's tables, at once the corresponding percentage of alcohol, from the specific gravity found.

4. The determination of ash.

One hundred grams of beer (previously freed of carbonic acid) are carefully evaporated in a tarred platinum dish over a water bath to dryness, then at the lowest temperature incinerated till the residue is almost white, the weight of the residue gives the percentage of ash.

5. The determination of the total extract.

The extract may be determined directly, or indirectly, though I prefer the latter method, as requiring less time, and which when properly executed giving good results. About one hundred grams of beer (I prefer always to measure and weigh the beer, one will be a check on the other) are evaporated over a water-bath in a proper vessel, to about one-third of the original quantity; then mixed with distilled water to make up the exact quantity of the original beer and the specific gravity of this liquid taken 15° Celsius; from this the exact amount of extract is calculated by use of W. S. Schultze's tables.

6. The determination of sugar.

Fifty grams or cubic centimetres of beer are mixed with ten cubic centimetres of basic acetate of lead, and two hundred and forty cubic centimetres of distilled water; the mixture thoroughly shaken, and after some time filtered through a dry filter. Ten c. c. of Fehling's alkaline copper solution (of the usual strength) diluted with forty c. c. of distilled water is brought to a boil in a white porcelain dish; the discolored and diluted beer is then slowly run in from a one-tenth c. cm. burette, until the blue color has disappeared and until a filtered portion of the boiling liquid acidified with acetic acid, gives no precipitate on addition of ferrocyanide of potassium. Two tests are usually sufficient to obtain correct results; care must be taken not to add too much of

the diluted beer. The calculation, if, for instance, eighteen c. cm. of diluted beer had been used, is as follows:

$$18 : 0.65 = 300 : xx = 83$$

$$50 : 0.03 = 100 : xx = 1.66 \text{ p. c.}$$

Since maltose-sugar possesses less power of reducing Fehling's solution than grape-sugar, the calculation must be made accordingly—10 c. cm. Fehling's alkaline copper solution are reduced by 0.05 grams of grape-sugar and 0.075 grams of maltose-sugar.

7. The determination of dextrine.

Ten c. cm. or grams of beer, freed of carbonic acid and alcohol by evaporation to one-third original bulk, are hermetically sealed in a strong glass tube with one or one and one-half cubic centimeter of pure diluted sulphuric acid, and heated for about six hours in an oil bath between 108 to 110° Celsius. In the contents of the tube the total amount of sugar is determined as previously described with Fehling's solution, after neutralization with caustic soda solution and proper dilution with distilled water. To be certain that all copper has been reduced, I filter a little of the solution and add a few drops of grape-sugar solution to the filtrate and boil; the least trace of unreduced copper solution is indicated by a greenish yellow cloudiness in the boiling liquid. Deducting from the total amount of sugar (grape) found in this operation, for one hundred parts of beer, the quantity due to the inversion of the maltose previously determined, gives us the quantity of grape sugar resulting from the inversion of the dextrine, ten parts grape sugar correspond to nine parts of dextrine.

8. The determination of the nitrogenous matter.

When required, I evaporate fifty grams of beer in a small tarred porcelain dish, drying it over a water bath for several days till the residue can be readily powdered. A portion of it is burned with soda lime, etc., and from the nitrogen found the albuminoid is calculated.

9. The determination of acidity.

One hundred grams beer, after removal of carbonic acid, are tested with a one-tenth caustic baryta solution with proper precautions, and the results obtained calculated for lactic acid.

10. The determination of phosphoric acid.

One hundred grams beer, after removal of carbonic acid, are transferred to a beaker, a few cubic centimetres of acetate of potash added, and the mixture heated and then titred with standard solution of uranium acetate. Ferrocyanide of potassium solution serves as indicator, or we take the ash of the beer, remove lime, etc., in the usual way, and determine phosphoric acid gravimetrically using magnesia mixture as a precipitant. For dark beers this method is preferable.

11. Other constituents.

In regard to the determination of other constituents of beer, such as glycerine, gum-like substances, etc., the separation of lactic, acetic acids, etc., and the various nitrogenous substances (peptones) found in beers, I must refer to the special literature on this subject. Fresenius' Zeitschrift, the Analyst, etc.

If a complete analysis of the beer is required, Fresenius' Quantitative Analysis gives all the required information.

There is a great number of beer analyses on record, but I must confine myself to giving one or two of each peculiar kind or brand of beer, which may be found in table X on the next two pages.

TABLE X.—*Composition of Malt Liquors.*

No.	NAME.	Specific gravity.	Water per cent.	Carbonic acid per cent.	Alcohol. Per cent. by volume.	Alcohol. Per cent. by weight.	Extractive matter per cent.	Albuminoids per cent.	Sugar per cent.	Dextrine per cent.	Glycerine per cent.	Acid per cent.	Ash per cent.	Phosphoric acid per cent.
1	Common Beer, Rose in Jena (Thuringen)		90.04		1.88				0.304	7.71				
2	Bodenbach Abzugbier (Austria)		93.30	0.258		2.02	4.42	1.55	0.604	2.24			0.163	
3	Wiesbaden Dunnbier (Nassau)				2.86				1.910					
4	Upsala Beer (Sweden)		88.10		3.00		8.90							
5	Hofbrau Weissbier, Munich	1.0129			3.51		4.73	0.53					0.150	0.0893
6	Brunner Abzug Bier, one month old	1.0136	92.40			2.85	4.75	0.36			0.10	0.18		
7	Reisbier, Mayence (Prussia)				3.66		7.36	0.37	1.630	5.13			0.220	0.0770
8	Hofbrau Sommer-Bier, Munich	1.0141			3.88		4.93	0.43					0.230	0.0747
9	Botzow's Brauerei Bier, Berlin		91.12			3.10	5.78						0.207	
10	Winterbier-Augustinerbrau, Munich	1.0180		0.140	3.90		5.90							
11	Bodenbach Schenkbier (Austria)		92.15	0.248		3.12	4.48	1.57	0.563	2.23			0.173	
12	Bayerisches Bock Bier, Munich	1.0207		0.085	3.92		8.52							
13	Baseler Bier (Brandlin Lager)	1.0118		0.262		3.16	4.87		0.800				0.220	0.0240
14	Bavarian Beer, Stockholm		88.60		4.00		7.40			some.		lactic.		
15	Sour Beer, north of France				4.00		4.04		0.700				0.160	
16	Hofbrau Lager Bier, Munich		89.21		4.02			0.02	0.351	6.19		lactic. 0.202		
17	Baseler Bier (Brandlin Pale Ale)	1.0120		0.205		3.23	5.02		1.000				0.210	0.0280
18	Doppelbier, Wiesbaden (Nassau)				4.23		6.40		1.111				0.240	
19	Erlanger Winterschenk Bier, 1874–5					3.39	6.21							
20	Hofbrau Sommer-Bier, 1846. Munich	1.0110		0.160	4.40		3.90							
21	Pilsener Bier (Austria)	1.0129	91.30	0.140		3.55	5.15						0.197	
22	Hofbrau Zacherl Salvator Bier, Munich	1.0333			4.49		9.63	0.67						
23	Mumme, Brunswick	1.2310		0.12		3.60	47.60							
24	Starkbier, Stockholm (Sweden)		83.00		4.60		12.40							
25	Paris Beer (France)				4.70		6.19		1.430				0.260	
26	Schweehas Marzen Bier	1.0169	90.29			3.83	5.88	0.48				0.14	0.210	
27	Kieler Bier, Waldschlosschen		89.66			3.84	6.50							0.0880
28	Culmbacher Bier (Bavaria)	1.0228	88.62			4.00	7.36	0.53				0.16	0.260	
29	Bofenbach Lagerbier (Austria)		89.93	0.445		4.00	5.63	1.98	0.501	3.01			0.519	
30	Canton Luzern Beers, average	1.0163			5.02		6.18		0.883		0.218		0.230	0.0690
31	Hofbrau Bock Bier, Munich	1.0247			5.08		7.83	0.87					0.280	0.0967
32	Brunner Lagerbier, 5 months old	1.0140	90.76			4.07	5.17	0.45				0.16	0.081	
33	Tivoli Beer, Berlin		90.72			4.15	5.14						0.191	
34	Liesinger Lagerbier (Austria)	1.0256	87.66			4.28	8.08	0.64				0.23	0.360	
35	Sweet Beers. Amsterdam				5.37		7.00		1.630				0.220	
36	Jopen Beer, Danzig (Prussia)	1.2080	49.50			4.30	46.30						1.500	0.2820
37	Karwin Salonbier	1.0285	87.19	0.250		4.36	8.45						0.312	
38	Brunner Marzen, 14 months old	1.0167	89.50			4.39	6.11	0.43				0.19	0.270	
39	Erlander Sommerbier, 1875					4.50	4.81		0.400	1.44			0.480	
40	Heiliger Vater Bier	1.0304		0.077		4.94	13.03							
41	Lambic Beer, 1872. Brussels					5.94	3.30		0.480			11.00		

42....	Tetschen Bockbier (Austria)	....	86.18	0.502	....	6.11	7.21	2.50	0.665	3.09	....	....	0.248	....
43....	Lambic Beer, 1869. Brussels	....	....	....	....	6.20	2.97	....	0.082	....	....	12.90	....	....
44....	Barclay & Perkin's Ale. London	....	....	0.160	5.40	....	6.00	....	....	....	....	....	....	....
45....	Pale Ale "A," Burton	....	....	....	60.5	....	5.05	....	0.830	....	....	....	0.280	....
46....	Ale	1.0106	89.76	....	....	5.43	4.81	0.57	....	....	....	0.310	0.360	....
47....	Scotch Ale, 2 years old	....	....	0.150	8.50	....	10.90	....	....	....	....	....	....	....
48....	Stockholm Porter	....	87.40	....	6.00	....	6.60	....	....	....	....	....	....	....
49....	Porter	1.0207	86.85	....	....	5.72	7.43	0.83	....	....	....	0.340	0.400	....
50....	Dublin Porter	....	83.45	....	9.04	....	8.49	0.79	0.34	7.72	....	acetic. 0.35	0.420	....
	Composition of Beer Minimum (According to Konig.)	1.0100	83.00	0.100	1.63	....	2.60	0.02	0.100	1.46	0.07	0.080	0.140	0.020
	Composition of Beer Maximum (According to Konig.)	1.0340	95.27	0.500	9.04	....	12.40	1.98	2.450	7.85	0.71	0.400	0.480	0.090

Analysts—Nos. 6, 26, 28, 32, 34, 38, 46, 49, by Fr. Schwackhofer; 10, 20, 23, 44, 47, by Kayser; 2, 11, 29, 42, by Th. v. Gohren; 5, 8, 22, 31, by C. Lermer; 15, 25, 35, 45, by E. Monier; 13, 17, 30, by Goppelsroder; 3, 18, by Engelmann; 19, 39, by A. Hilger; 21, 37, by Kohlraush; 12, 40, by Leo; 41, 43, by Lintner; 1, 16, by Wackenrode; 36, by Helm; 27, by Himley; 50, by Jackson and Wonfer; 7, by Mets; 4, 9, 14, 24, 33, 48, unknown.

Analyses of Lager Beers.

In regard to the samples of beer sent to me by the State Inspector, I must remark that, with the exception of the last sample, they were all present use beer, some very young indeed, full of yeast cells, and in such a state of after fermentation that quite a number of the bottles containing the samples burst before they could be analyzed. The analysis of them, therefore, had to be restricted to the main ingredients and substitutes for hops as far as it was possible. The results are contained in the following table:

TABLE E.—Results of the Examination of Lager Beers.

Inspector's number.	Specific gravity.	Alcohol per cent. by weight.	Extractive matter per cent.	Sugar per cent.	Acid per cent.	Ash per cent.	Phosphoric acid per cent.
343	1.0203	1.45	7.26	2.00	0.188	0.327	0.105
344	1.0157	2.96	6.14	1.90	0.238	0.312	0.126
345	1.0153	2.23	5.25	1.66	.....	0.255	0.094
346	1.0181	2.47	6.63	2.30	.... .	0.303	0.126
347	1.0180	2.41	6.41	1.89	0.216	0.327	0.108
348	1.0131	3.96	5.53	2.06	0.234	0.280	0.110
349	1.0157	2.94	6.19	1.80	0.207	0.315	0.121
350	1.0140	2.36	5.89	1.25	0.216	0.331	0.108
351	1.0102	4.14	4.58	1.10	.....	0.283	0.091
352	1.0198	1.80	7 04	1.65	0.207	0.321	0.103
354	1.0174	3.19	6.07	2.06	0.252	0.320	0.095
530	1.0183	2.93	6.19	2.03	0.117	0.321	0.098
532	1.0156	2.69	5.82	1.17	0.171	0.302	0.112
533	1.0132	2.29	5.40	1.15	0.090	0.268	0.087
534	1.0160	2.25	5.45	1.20	0.117	0.301	0.112
535	1.0174	1.77	6.55	1.93	0.207	0.318	0.082
536	1.0184	3.49	6.39	1.28	0.216	0.347	0.105
537	1.0217	2.38	7.21	1.49	0 198	0.289	0.110
551	1.0103	3.14	4.90	0.98	0.147	0.261	0.110
Average	1.01623	2.781	6.047	1.521	0.1888	0.3048	0.1054

The Adulteration of Beer.

There is perhaps no class of manufacturers of articles of food and drink, which has been subjected to graver charges of adulteration than the beer brewers.

The following list of adulterants, taken from, "Das Bier, seine Verfälschungen und die Mittel, solche nachzuweissen," von Dr. R. Stierlin. Bern, 1878, gives some idea of the subject.

Indian cockle (fish berries), opium, extract of poppy, Saint Ignatius beans, strychnine, tobacco, wild pepper, colocynth, marsh tea, henbane, belladonna leaves, nitric acid, aloes, quassia, willow bark, colombo root, gentian, sweet flag, tumeric, worm wood, marsh clover, blessed thistle, horehound, European centaury, orange peal, licorice (extract of), molasses, honey, decoction of flax-seed, burnt flour, burnt sugar, burnt molasses, burnt malt, juniper berries, Spanish pepper, ginger, coriander seeds, anise seeds, fennel seeds, caraway seeds, grains of paradise, cassia buds, isinglass, decoction of calves feet, glue, albumen, ivory black (for clearing), gypsum, alum, sulphuric acid, carbonate of lime (as egg-shells, oyster-shells, marble and chalk), carbonate of potash, carbonate of soda, salt, copperas, salicylic acid, glycerine, whisky and water.

As far as the detection of the above-mentioned and other adulterants and substitutes for hops and malt in the manufacture of beer is concerned, I can say but this, that it is a very accurate and difficult work, and my limited space will not permit me to enter into any details, but I can only refer to the authorities already quoted. That some of these substances just enumerated have been and are used when hops are high in price is unquestionable. A. F. Zimmerman in his "Aus führliches Lehrbuch der Bierbrauerei, Berlin, 1882, on page 50, et seq., gives the following harmless (to health) substitutes:

1. Gentian, one pound finely cut equal to twelve pounds of good hops in bitterness, though recognized in smell and taste.

2. Marsh clover, one pound equal to five pounds of hops, recognized by the taste in the beer.

3. Yarrow, one pound of it equal to two pounds of hops.

4. European centaury, one pound equal to three pounds of hops in bitterness, but wanting in aroma.

5. Blessed thistle, six pounds of it equal to one of hops in bitter principle.

6. Wormwood, one pound equal to twelve pounds of hops, it is unpleasant, bitter and always recognized by the taste in the beer.

7. Bitter milkwort, is but slightly bitter in the root.

8. Quassia, one pound of which is equal to sixteen pounds of hops in bitterness; and, "although the balsamic flavor of the hops is entirely wanting, it must really be considered in beer brewing the main substitute for hops, and may be used without detriment in the manufacture of beer in times when hops are very expensive, though only from one-fourth to one-third of the required quantity of hops can be replaced by it, since it produces in the beer a too intense bitterness if more is added, readily recognized by the tongue."

To impart flavors to beer the same author mentions the following substances: coriander seeds, grains of paradise, orrisroot, Spanish majoram, cinnamon, nutmegs, cloves, green oranges dried, etherial oils of anise and carraway.

Substances used which are injurious to health are, Indian cockle, marsh tea, white hellebore, Saint Ignatius beans, juniper berries, dog button.

The fruit of Ptelea Trifoliata, the so-called hop tree, has been lately recommended as a substitute for hops. According to the "Allgemeine Medicinische Pharmaceutische Flora von O. J. Kostolezky, B. v. No. 1783, Mannheim, 1836," it has been used previously for the same purpose. Mr. Pousard exhibited in 1879 at the agricultural fair at Chalons-sur-Marne specimens of beer in which it was used as a substitute for hops, and which ranked as samples of beer according to quality and aroma.

Among the substitutes for malt, the most important are rice, corn, starch, potatoes and sugars. To five hundred or seven hundred pounds of malt one hundred pounds of rice may be added, but at the same time an increase in hops is required. When employing corn, two-thirds of barley malt to one-third part of corn is required. One part of potatoes or starch require one and one-half parts of malt with an addition of from one and one-half to one-tenth of ground wheat, oats or barley, by the addition of which the wort clarifies and ferments better. It is stated that while one hundred pounds of barely malt give four hundred and forty pounds of wort of 12°, one hundred pounds of starch give six

hundred and sixty pounds of the same strength, and one hundred pounds of sugar are about equal to 165.3 parts of malt, but beer made with the latter two substances is poor in phosphoric acid and albuminoids, hence incapable of supporting the life of the yeast properly, and which compels the brewer using these substitutes from time to time to brew beer of barley malt, hops, yeast and water only, to obtain good yeast, or to purchase the latter if he can from another brewer.

Rye is not well adapted for the manufacture of beer; oats are better.

To increase fermentation in beers (lager, etc.), it is recommended to add undried or air-dried malt, malt meal, carbonate of ammonia, etc.; while for its reduction the addition of strongly roasted malt, a larger addition of hops, the addition of acids, — tartaric acid, alkalies, carbonate of ammonia and its salts and gypsum, — are recommended.

To impart to the beer a taste of pitch, we find it recommended to dissolve some pitch in alcohol from 80 to 90° Tralles, and adding of this solution as much as required.

For the manufacture of potato beer twelve measures, each of one hundred and ten pounds, of malt, twelve measures of potatoes, six pounds of hops, and one and one-half ounce of Irish moss, together with one-half quart of good yeast are recommended.

For Merseburger beer use:

Twenty-one measures of ordinary malt, six measures of dark burnt malt, twenty-four pounds of good hops, one and one-half pounds of Irish moss, and one-quarter quart of yeast.

For Erlanger beer take:

Twenty-four bushels at sixty pounds of barley malt, eighteen pounds of hops, one pound of coriander seeds, and one and one-half pound of Irish moss.

For Grünthaler Doppelbeer take:

Twenty-four bushels, at sixty pounds, good malt, forty-eight pounds of hops, one hundred and ninety-two pounds of sugar, beet sugar rafina, one pound of coriander seeds, one-half pound of grains of Paradise, and one and one-half pound of Irish moss.

I might multiply these recipes, but those given will be sufficient for my object, viz.: to show that beers having a certain local name receive larger or smaller additions of substances in themselves harmless to health, but not in accordance with the definition of *pure* beer.

To give to beers, especially those that have been made by substituting a portion of the barley malt by grape sugar, glucose, starch, potatoes, etc., the required viscosity (Vollmündigkeit) and ash constituents (albuminoids and phosphates), wheat bran and phosphates of the alkalies are recommended; glycerine is used for the same purpose. The latter, it is asserted, is especially valuable for export beers to prevent fermentation induced by changes in temperature, though lately boracic acid, salicylic acid and Pasteur's method are undoubtedly more employed.

In regard to the use of the two former substances, it would be proper for the Board of Health to prohibit their indiscriminate use till sufficient and well made experiments shall show conclusively that their daily use, even in small quantities, is not injurious to health.

Although corn, rice, wheat, grape sugar, glucose, starch, potatoes, etc., have been and are used in the manufacture of beers in various countries, the use of substitutes for hops within the last few years is hardly possi-

ble to believe, since hops have been so cheap, in fact, almost the cheapest bitter, and are, moreover, as every brewer knows, the best material to preserve his beer. That cocculus indicus (Indian cockle) cannot have been used to any extent is evident from the amount imported into the United States during the years 1879 to June 30, 1880, viz.: nine thousand eight hundred and sixty-two pounds. One pound of this drug is considered equal to two bushels of malt. Moreover the use of substances to give intoxicating qualities to beer, we should, in fact, not charge to the brewers, since their object undoubtedly is to sell as much beer as possible, hence the less alcohol or intoxicating qualities their beer contains the more will be consumed.

Very respectfully,
F. E. ENGELHARDT, Ph. D.

LITERATURE OF MALT LIQUORS.

I. *Journals*

1. Archiv für Russische Bierbrauerei. Moskau.
2. Bierbrauer. Der Bierbrauer. Herausgeber, Dr. C. Schneider, Leipzig.
3. Bierbrauer. Der Americanische Bierbrauer. Herausgeber, Dr. Schwarz, New York.
4. Bierbrauer. Der Bayerische Bierbrauer. Herausgeber, Dr. Lintner, München.
5. Bierbrauer. Bayerscher Bierbrauer. Langer and Schultze, 1879.
6. Bierbrauer. Der Böhmische Bierbrauer. Redacteur, A. D. Schmelzer, Prag.
7. Bierbrauer. Der Bierbrauer aus Böhmen. Prag.
8. Bierbrauer. Der Schwäbische Bierbrauer. Redacteur, W. Achenbach, Waldsee, Württemberg.
9. Bierbrauerei. Allegemeine Zeitschrift für Bierbrauerei und Malz, fabrication. Wien.
10. Bierbrauerei. Die Bierbrauerei. Milwaukee.
11. Brasseur. Le Sedan.
12. Brauer-Journal, Malz und Hopfenrevue. New York.
13. Brauerei. Saazer Brauerei — Fachblatt Redacteur Anton Markl, Nürnberg.
14. Brauerei. Kalender, herausgegeben von Albert Hayn.
15. Brauer. Fromme's Brauer und Mälzerei-Kalender. Redacteur, Franz Fasbender, Wien.
16. Brauerzeitung. Elsässische Hopfen und Brauerzeitung. Hagenau.
17. Brauerzeitung. Schlesische Brauerzeitung, Breslau.
18. Brauerzeitung. Norddeutsche Brauerzeitung. Berlin.
19. Brauindustrie. Vereinsblatt des Brauindustrie vereins für das Königreich Böhmen, redigirt von J. Heinde in Prag.
20. Brauwesen. Zeitschrift für das gesammte Brauwesen. Redacteur Dr. C. Lintner.
21. Brauwesen. Fach und Handelszeitung fur das deutsche Brauwesen. Redacteur Lertz. Nurnberg.
22. Brewer. The Western Brewer. Chicago and New York.

23. Brewers. The Brewers' Gazette, New York.
24. Brewers. The Brewers' Guardian, London. J. A. Pooley, Editor.
25. Brewers. The Brewers' Journal, London. F. W. Lyon.
26. Brewers. The German and American Brewers' Journal, New York.
27. Brewers. American Brewers' Gazette, New York.
28. Elsässische Hopfen und Brauerzeitung. Hagenau im Elsas.
29. Homann, C. Deutscher Braukalender, Nurnberg, 1878
30. Hopfenzeitung. Allgemeine Hopfenzeitung. Editor J. Carl, Nurnberg.
31. Jahresbericht des Laboratoriums der wissenschaftlichen Station fur Brauerei in München, 1877–78. Freising, 1878.
32. Journal des Brasseurs. Dr. Povrez Lille.
33. Le Brasseur. Edited by M. G. Bahon. Sedan, Ardennes.
34. Le Moniteur de la Brasserie. Editor M. A. Laurent, Bruxelles.
35. Meddeleser faar larsberg Laboratoriet. Udgive ved Laboratoriets Bestyrelse. Forste Hefte 1878. Andet Hefte 1879, Kjöbenhavn.
36. Revue des Bières. Dr. J. P. Roux, Bruxelles.
37. Revue universelle de la Brasserie et de la Destillerie. Bruxelles et Paris.
38. The various Journals and year-books relating to Chemistry-Pharmacy, Agriculture, Technology, etc.

II. *Special Works.*

1. Assmus, Dr. E. Die Fabrication der Zuckercouleur. Rum-Essig-Bier-Couleur, Berlin. Julius Springer.
2. Babcock, Prof. James F. Second annual report of Inspector and Assayer of Liquors, of the Commonwealth of Mass. Boston, 1877.
3. Balling K. Die Bierbrauerei. Prag.
4. Balling, K. Anleitung zum Gebrauche des Saccharometers by der Erzeugung und Prüfung der Bierwürzen, etc.
5. Balling, A. Der Getreidestein. Zeilithoid und seine Anwendung zur Biererzeugung.
6. Belshoubek, A. Einige Worte über den Bau und die Einrichtung von Brauereien. Prag.
7. Bersch, J. Gährungschemie für Practiker, etc., Berlin. Erster Theil, die Hefe und die Gährungserscheinungen.
8. Beyse. Katechismus der Kellerwirthschaft. Wien, 1872.
9. Bier. Das Bier vorzüglich das Bairische Bier als Beforderungs quelle der Gesundheit, etc. Augsburg, 1855.
10. Bieranalyse. Tabelle zur Bieranalyse, welche mittelst des Saccharometers allein ausgeführt wird. München, 1877.
11. Bierbrauer, der Ulmer, oder Angabe aller Braugeheimnisse und Vortheile in der Construction and Einrichtung einer Brauerei nach Ulmer Art, etc. Tuttlingen, 1859.
12. Biere, trube. Die Ursache der Trübung und die Klärmittel. Prag.
13. Black, W. A practical treatise on Brewings. 5th Edition, London, 1875.
14. Blondeau, Ch. La science de la brasserie. De la biére, de sa fabrication par anciens et par les nouveaux procédés, et specialement par l' emploi des caves froides. Aix (Bouches du Rhone), 1878.
15. Böhm, H. Neues Maischverfahren mit 40–50 p. c. Gerste Ersparniss, Berlin.

16. Böhm, H. Neuestes Verfahren zur Bereitung der Schlempe, Hefe. Berlin.
17. Boss, Joh. Geo. Erfahrungen eines bairischen Bierbrauers über die Art und Weise, stets ein gleichmässig kräftiges, wohlschmeckendes und helles Bier zu erzeugen. 3. Auflage. München, 1852.
18. Brewing. The art of brewing. London.
19. Brewing. Prize essay on practical brewing. London, 1879.
20. Büchner, Carl. Die bairische Bierbraueri und ihre Geheimnisse, etc. Leipzig, 1852.
21. Byrn, M. L. The complete practical brewer. Philadelphia, 1869.
22. Carl, Ferdinand. Bierproductionkarte von Mitteleuropa. Nürnberg, 1876.
23. Cartuyvels, Jules, et Ch. Stammer. Traité complet, théorique et pratique de la fabrication de la biére et du malt. Bruxelles und Liège, 1879.
24. Chupp, Moritz, Dr. Julius, Ritter von Chonau. · Verzehrungssteuer von Bier in Oesterreich-Ungarn. Prag, 1877.
25. Creuzburg, H. Theorie und Praxis der Bierbrauerei, dargestellt in kurzen leicht fasslichen Sätzen. Weimar, 1865.
26. Danneh1, Gustav. Die Verfälschung des Bieres. Ein Wort an das Reichskanzleramt. Berlin, 1877.
27. Detmer, Dr. W. Physiologie des Keimungprocesses der Samen. Jena, 1880.
28. Doberosch, G. B. Das Bier ein lebendes Wesen; dessen Krankheiten; die Mittel gegen dieselben, nebst den einschlägigen Proben in Betreff seiner Stärke und Schwere. Giessen, 1857.
29. Ebert, Braunsberg L. Der Brauereibesitzer. Zusammenstellung der gesetzlichen Bestimmungen in Betreff der Errichtung, Betrieb und Besteuerung der Brauereien.
30. Ensiger, L. Die Anatomie des Gerstenkornes und die Vorgänge beim Wachsthumprocess. Leipzig, 1876.
31. Fasbender, F. Mechanische Technologie der Bierbrauerei und Malzfabrication, 1881.
32. Fasbender, F. Katechismus des practischen Brauwesens. 2. Auflage, Wien, 1879.
33. Fasbender, F. Dic Anlage einer Bierbrauerei mit specieller Berücksichtigung der Wiener Brauart. Leipzig, 1872.
34. Fasbender, F. Denkschrift an den internationalen Brauer-Congress im Jahre 1873. Wien.
35. Faulkner. The Art of Brewing, practical and theoretical. London, 1876.
36. Feuchtwanger, Lewis. Fermented liquors, etc., New York, 1867.
37. Fluhrer. Die Diastase. Eine Zusammenstellung der Untersuchungen über die Vorgänge beim Maischen. München, 1870.
38. Fluhrer, Wilhelm. Die Diastase, eine ausführliche Zusammenstellung der Untersuchungen uber die Vorgänge beim Maischen. Munchen, 1870.
39. Frentz, Adolphe. Redacteur-en-chef du Moniteur de la Brasserie, Bulletin du Congrès international de Brasserie, tenue a Bruxelles du 12 au 16 Sep., 1880. Bruxelles.
40. Galland, N. Pneumatische Malzerei. Fortsetzung der faits et observation sur la brasserie. Nancy.
41. Galland, N. Nouvelle méthode de fermentation de la bière. 1876.

42. Gerstenbergk, Heinro, von. Winke fur Braumeister und Brauherren, etc. Weimar.
43. Gerstenbergk, Heinrich von. Geheimnisse und Winke fur Braumeister, etc. 3 Auflage. Weimar, 1866.
44. Gerstenbergk, Heinr. von. Neuer tabellarischen Fassbezeichner nach Litergemäss. Weimar, 1877.
45. Gesetz wegen Erhebung der Brausteuer vom May, 1872, nebst Ausfuhrungsbestimmungen. Berlin, 1872.
46. Goldschmids. Die Brauindustrie auf der Weltaustellung zu Philadelphia. Bericht an die Commission des deutschen Reiches.
47. Gräger, Dr. N. Die Kellerwirthshaft, oder die Behandlung des Weines, und des Bieres in Gebinden und Flaschen im Keller, 3. Auflage. 1877.
48. Grässe, Th. Bier-Stadien, Geschichte und Verbreitung des Bieres, Dresden, 1873.
49. Habich, G. E.; Die Schule der Bierbrauerei. 3. Auflage. Leipzig.
50. Habich, G. E. Taschenbuch der Chemie des Bieres. Ein Rathgeber für practische Bierbrauer. Leipzig, 1858.
51. Habich, G. E. Kurse Darstellung meines in Nord Amerika patentirten Dampfbrau-und Kuhl-Apparates. Quedlinburg, 1863.
52. Habich, C. F. Die Malzbereitung. Chemie derselben, nebst Beschreibung, etc.
53. Habich, C. F. Offene Fragen in Sachen der Bierbrauerei, 1867.
54. Habich, C. F., sen. und H. Habich, jun. Atlas von Constructionszeichnungen der bewährtesten Geräthe, Maschinen, etc., für Bierbrauerei. 2. Auflage, Leipzig, 1869.
55. Hallier, F. Die Gährungserscheinungen. Leipzig.
56. Hanamann, B. J. Eine Darstellung de belangreichsten Erfahrungen, Verbesserungen und neuesten Fortschritte im Brauwesen. als ein Beitrag zur Hebung und Förderung der Bierbrauerei. Im Selbstverlage. Leitmeritz, 1873.
57. Hannamann, Dr. J. Hefe und Alkoholgahrung nach dem heutigen Standpunkte der Wissenschaft. Leipzig, 1878.
58. Hannamann, Dr. J. Die Dickmaischbrauerei mit besonderer Berücksichtigung des altbairischen Brauverfahrens vom chemischen Standpunkte beleuchtet. Munchen, 1862.
59. Hartmann. Das Bier und seine Pflege. Ein Handbuch fur Restaurateure und Bierverleger. Dresden.
60. Harz, Dr. C. O. Grundlage der alkoholischen Gährungslehre. München, 1877.
61. Heiss, Phil. Die Bierbrauerei mit besonderer Berücksichtigung der Dickmaischbrauerei. Nebst einem Anhange, enthaltend die im Brauereibetriebe gebräuchlichsten Rohstoffe und de en Verwendung. Neu bearbeitet von Enul Leiser. 7. Auflage. Leipzig, 1881.
62. Heiss, Phil. Ueber die im Braubetriebe gebräuchlichsten Rohstoffe und deren Verwendung, etc. 2. Auflage. 1860, Augsburg.
63. Hehner, Otto. Alkohol-Tafeln. Wiesbaden, 1880.
64. Hercher, Braumeister Heinrich. Die bairische Bierbrauerei in Kurzer Zusammenstellung aus der Praxis mitgetheilt. Stuttgart, 1865.
65. Holzer, Dr. G. Die Attenuationslehre fur Zymotechniker und höhere Lehranstalten. Freising, 1876.

66. Holzner, Dr. G. Tabelle zur Berechnung des Aufmasses und des Bierpreises nach dem Litermass. München.
67. Holzner, Dr. G. Tabelle zur Bieranalyse, welche mittelst des Saccharometers und Thermometers allein ausgeführt wird. Munchen.
68. Karlowa. Die Bierfabrication. Swinna, 1880.
69. Klenke, Dr. Herrmann. Illustrirtes Lexicon der Verfälschungen der Nahrungsmittel und Getränke. Leipzig, 1878.
70. Kollmann, Ant. Anhaltspuncte sur Benutzung bei Bier-Untersuchungen fur Landesgerichts Beamte, Gerichsarzte, practische Aerzte und Apotheker. Augsburg, 1857.
71. Kuhnemann G. Patentirtes Verfahren der Gewinnung von Gersten Extractzucker, loslichen Eiweisstoffen, Amylodextrin und Mcl auf chemischem Wege, etc.; nebst Bereitung von Dermatiose. Berlin.
72. Langer, Th. Lehrbuch der Chemie mit besonderer Berucksichtigung der Gahrungsgewerbe. Leipzig, 1878.
73. Langer. Jahresbericht der ersten Oesterreichischen Brauerschule in Modling.
74. Les Industries agricoles ; sucrerie, distillerie, brasserie,vins, etc. Par Ronna. Paris.
75. Levesque. The art of Brewing and Fermenting and Making Malt. London.
76. Leyser. Musterbrauhaus. 1877, Prag.
77. Lintner, Dr. Carl. Lehrbuch der Bierbrauerei vom heutigen Standpuncte der Theorie und Praxis. Erster Theil zu Otto Birnbaum's Lehrbuch. 7. Auflage, Braunschweig, 1878.
78. Lintner, Dr. C. Mittheilungen uber die ins Braufach einschlagigen Ausstellungsobjecte der Wiener Weltausstellung. Munchen, 1873.
79. Loftus. The Maltster; a treatise on the art of malting in all its branches, illustrated. London, 1876.
80. Mair, A. Das Hopfenschwefeln und die Hopfenschwefeldarren. Nurnberg, 1869.
81. Mair. Das Bier und dessen Untersuchung. Munchen, 1864.
82. Markl, A. K. Die Brauerei-Instrumente ihre Prufung und ihr Gebrauch. Saaz.
83. Mayer, Dr. Ad. Lehrbuch der Gahrungschemie. Heidelberg, 1876.
84. Mayer, Dr. Ad. Beitrage zur Lehre uber den Sauerstoffbedarf und die Gahrungserregende Flussigkeit der Hefenpilze.
85. McCulloch. Distillation, Brewing and Malting. San Francisco, 1867.
86. Merkel, W. Sammlung von saccharometrischen Tabellen zur rationellen Anwendung des Densi-Saccharometers in der Brennerei und Braverei. Leipzig, 1872.
87. Messerschmidt, J. A. Die bairische Bierbrauerei im Allgemeinen, insbesondere die in Bamberg und Umgebung ubliche Brauart nach ihrem ganz Umfange practisch beschrieben. Nurnberg (3. Auflage, 1854).
88. Metz, A. Untersuchung des Reisbieres. Munchen, 1870.
89. Metz, A. Areometrische Analyse des Bieres. Munchen, 1870.
90. Michel, Carl. Lehrbuch der Bierbrauerei. Im Sebstverlage des Verfassers.
91. Michel, Carl. Mittheilungen fur Bierbrauereibesitzer und Malzfabrikanten. Augsburg.

92. Mittheilungen uber das Deutsche Malz und Braugeschaft. Trier.
93. Muller, G. J. Die Chemie des Bieres. Leipzig, 1858.
94. Muller, Aug. Ernst. Das neue Brauverfahen mit den hiezu construirten Apparaten. Pressburg, 1854.
95. Muller, Aug. Ernst. Die Bier-Reform oder die Grundzuge und die Resultate der Neuen Brauverfahrens mit den hiezu construirten Apparaten. Pressburg.
96. Muller, P. Handbuch fur Bierbrauer. Braunschweig, 1854.
97. Munk, Ch. Die Nachtheile des Hopfenschwefelens fur Bierbereitung und die Gesundheit der Biertrinker. Augsburg, 1862.
98. Mintz, J. P. L. Das Bierbrauen in allen seinen Zweigen, etc., Plauen.
99. Nageli, C. Theorie der Gahrung. Munchen.
100. Noback, G. Die Bierbrauereien in Oesterreich-Ungarn, deren Statistick und volkswirthschaftliche Bedeutung. Prag, 1880.
101. Noback, G. Bierproductionskarte von Oesterreich-Ungarn. Prag, 1872.
102. Noback, G. Officieller Ausstellungsbericht, herausgegeben durch die General-Direction der Weltausstellung. Bier, Malz, sowie Maschinen und Apparate fur Brauereien und Malzereien. Wien, 1874.
103. Noback, G. Die Bierproduction in Oesterreich-Ungarn, im Deutschen Reiche, etc. Herausgegeben bei Gelegenheit der internationalen Brauerversammlung in Wien wahrend der Weltaustellung, 1873.
104. Pasteur, M. L. Die Alcohol-Gahrung. Deutsch von Dr. Griessmayer. Augsburg.
105. Pasteur, M. L. Etudes sur la biére, ses maladies, causes, etc. Paris, 1876.
106. Pasteur, M. L. Studies on Fermentation. The diseases of beer, their causes and means of preventing them ; translated by L. Faulkner and D. C. Robb. London, 1879.
107. Peltz E. and R. Habich. Practishes Hand- und Hulfsbuch fur Bierbrauer und Malzer. Braunschweig, 1876.
108. Pfantsch. Illustrirtes Taschenbuch der bairishen Bierbrauerei. Stuttgart, 1870.
109. Piesse, Charles H. The chemistry in the Brewing Room. London, 1877.
110. Pitt, J. How to brew good beer. A complete guide to the art of brewing ale, table ale, brown stout, porter, etc. London, 1864.
111. Planitz, Hans von der. Geschichte des Bieres (das Bier und seine Bereitung, einst und jetzt). Munchen, 1879.
112. Practical Brewing. A series of Prize Essays. London, 1879.
113. Prescott, Dr. Albert B. Chemical examination of alcoholic liquors. New York, 1875.
114. Reischauer, Dr. Carl. Die chemie des Bieres. Herausgegeben von Dr. Victor Griessmayer. 20 Auflage. Augsburg, 1882.
115. Rice for brewing. The utilizing of rice for brewing according to the latest scientific and practical experiences. New York, 1879.
116. Rion, A. Sammtliche Geheimnisse der Bierbrauerei, etc. Alleiniger Agent, Henry Guth. New York, 1870.

117. Rosenthal, Dr. J. Bier und Branntwein und ihre Bedeutung fur die Volksgesundheit. Berlin.
118. Roux, Paul J. Union gènèrale des Brasseurs (Pamphlet of the secretary of the society of brewers for South and Middle France.)
119. Rudiger, Herrmann. Technischer Brauereileiter. Die Bierbrauerei und die Malzextractfabrication. Wien.
120. Scammel, Geo. Breweries and malt houses, etc. 2d edition revised, enlarged and partly rewritten by Fred. Colyer.
121. Schmidt, Dr. C. H. Hausbierbrauer fur Staat und Land, etc. Herausgegeben vom Braumeister Wilhelm Grothe. Weimar, 1864.
122. Schmidt's, Chas. H., Grundsatze der Bierbrauerei. 4 ganzlich umgearbeitete und sehr vermehrte Auflage von Prof. Dr von Wagner. Weimar, 1870.
123. Schmidt. Deutscher Brauer und Malzerkalender. Nurnberg.
124. Schneider. Die Malzerei Chemie uud Physiologie der Malzbereitung. 2. Auflage an Stelle von Habich's Malzbereiting 1874.
125. Schneider, Konr. Erster Jahresbericht der Wormser Brau acadamie und Malzerei und Brauereiversushsstationo. Leipzig, 1873.
126. Schultz, J. F. Theoretisch practische Bierbrauerei, nach ihrer ersten Entwickelung bis zum jetzigen Standpunkte. Revidirt und mit den neuesten Erfindungen in der Kartoffelbierbrauerei versehen, vom Apotheker Dr. W. Keller, Berlin.
127. Schutzenberger, P. Die Gahrungserscheinungen. Leipzig, 1876.
128. Schutzenberger, P. On Fermentation. Appleton, New York, 1876.
129. Schwarz, Dr. H. Die alkoholischen Getranke. Wein, Bier und Branntwein. Breslau.
130. Schwarz, J. H. Neuer patentirter Bierbrauappart, der die vollstındigste Benutzung des Malzes, etc. Darmstadt, 1857.
131. Schwarz, Alois. Die Bierbrauerei auf der Weltausstellung. Brunn, 1871. Parnnon, R. A practical treatise on brewing, distilling and rectification, etc. London, 1805.
132. Simmonds, P. L. Hop culture, etc. Spon, New York.
133. Skalweit. (Bieranalyse mit dem Polarisationsapparate) Jahresbericht des Untersuchungsamts, etc., in Hannover.
134. Southby. Brewing, practically and scientifically considered. London, 1877.
135. Stahlschmidt, C. Die Gahrungschemie, umfassend die Weinbereitung. Bierbrauerei, Spiritus, und Essigfabrication. Berlin, 1861.
136. Steel. Selection of the principal points of malting and brewing and structures thereon for the use of brewery proprietors. London, 1881.
137. Stein, Carl. Gambrinus. Der vollkommene Bierbrauer oder vollstandge alle Zweige des Gewerbs umfassende theoretisch-practische Anleitung zum Bierbrauen. 3. Auflage. Heilbronn, 1852.
138. Steinheil. Optische Bieranalyse in der Abhandlung d. 2 Cb. d. Akademie der Wissenschaften zu Munchen. 3, page 691.
139. Stierlin. Das Bier und seine Verfalschungen. Bern, 1878.
140. Swoboda, Carl. Die Eisapparate der Newzeit, Weimar.
141. Thausing. The theory and practice of the preparation of malt and the fabrication of beer. Baird & Co., Philadelphia.
142. Thausing, Julius E., Prof. in Moidling. Die Theorie und Praxis der Maltzbereitung und Bierfabrication. Leipzig, 1877.

143. Thiel, Eugene. Nahrungs-und Genussmittel als Erzeugnisse der Industrie. Braunschweigh, 1874.
144. Thoms. Das Wasser in der Bierbrauerei. Riga, 1875.
145. Tietz. Ueber den Bau und die Einrichtung einer Brauerei. Wien, 1872.
146. Trautmann, Leonard. Anleitung zum Selbststudium der Doppelten Bierbrauerei. Worms, 1876.
147. Trempenau, Wilhelm. Die Brauereibuchfuhrung nach einfacher und doppelter Methode. Leipzig, 1877.
148. Utz, L. Die Vergahrbarkeit der milchsaure 1872. Wien.
149. Vocke. Handbuch für das Malzaufschlagwesen in Baiern. 2 Theile.
150. Vogel, Dr. August. Die Bieruntersuchung. Eine Anleitung zur Werthbestimmung und Prufung des Bieres nach den ublichsten Methoden. Berlin.
151. Voigt, Franz. Die Rohmaterialien zur Bierproduction, etc. Berlin, 1874.
152. Vogel, A. Die Bieruntersuchung. Berlin, 1866.
153. Wagner, L. V. Hefe und Gahrung nach dem heutigen Standpuncte der Wissenschaft.
154. Wagner, L. V. Die Bierbrauerei nach dem gegenwartigen Standpuncte der Theorie und Praxis des gewerbes. Weimar, 1877.
155. Wendt. Die Bierbrauer in ihren neuesten Fortschritten. Berlin.
156. Wenke, Dr. B. Zwei populare Vortrage uber den Brauprocess, Die Zusammensetzung des Bieres und die Wirkung seiner Bestandtheile auf den gesunden und kranken Körper. Weimar, 1861.
157. Wirncke, W. Ueber die Wirkung einiger Antiseptica und verwandter Stoffe auf Hefe. Dorpat.
158. Wing's Brewers Hand book for 1881.
159. Wolff. Die Naturklare oder das geheimniss der Hefe-und Alcohol-bildung und die unsichtbaren Feinde der Bierbrauerei, etc. Manheim.
160. Wright, A. Handbook for young Brewers. 1877.
161. Zimmermann, D. F. Ausfuhrliehes Lehrbuch der Bierbrauerei, etc. 2. Auflage. Berlin, 1852.
Consult also general list of works on the adulteration of food, etc.; analysis of food, etc.; also works on agricultural chemistry and chemical technology.

Group IX.

Crude Vegetable and Animal Drugs.

Group X.

Pharmaceutical Chemicals and their Preparations.

By Frederick Hoffmann, A. M., Ph. D.

Medicinal Drugs and Chemicals.

To the State Board of Health of New York:

Having been appointed by the State Board of Health of New York, to examine specimens of "Crude Vegetable Drugs" and "Pharmaceutical Chemicals and their Preparations," as presented to me by the chairman of the sanitary committee of the Board, I beg to present the following brief report on the results of my examination of 342 specimens of drugs, and of 317 specimens of chemicals, which were delivered to me on the 31st of October, the 7th and 16th of November, and the 1st of December. In consideration of the brief time granted for the present inquiry, for the necessary comparatively large amount of microscopical and analytical work, and for the delivery of the report, the inspectors were instructed, with the consent of the chairman of the sanitary committee of the Board of Health, to collect for the present examination, specimens of crude and of powdered drugs and of chemicals only; and of these such ones as are of importance, or which have been found wanting in quality according to recently published reports of analysts. As drugs and chemicals generally form the basis of pharmaceutical preparations, and as their good quality, therefore, is of prime importance, they have first been taken into consideration. The collection, as well as the examination of such extensive groups as the essential oils, and the whole series of pharmaceutical preparations proper, including the fluid extracts, the tinctures, the various solutions of salts, etc., for whose quality and strength the Pharmacopœia of the United States, and some other recognized Pharmacopœias are considered standards, require much more labor, time, apparatus and detailed methods for estimation, and considerably greater expenditure.

It is beyond the object and sphere of this report, to include and recite the known facts about the present condition of the drug trade, and about inferiorities and adulterations in drugs and medicinal chemicals, as found and published in the course of recent years in the current pharmaceutical and sanitary literature; nor to dwell upon, or advance suggestions in regard to needed or desirable measures of reform; it may, however, not be amiss in this respect, to refer to the elaborate "report on deteriorations, adulterations and substitutions of drugs," furnished by Prof. C. L. Diehl of Louisville, Ky., to the National Board of

Health, and published as supplement number six, among the publications of that Board.

It needs hardly to be stated that the examinations of drugs and chemicals has been conducted with the view to ascertain their identity and quality. These are liable to be impaired by accidental or intentional substitution, or by contamination resulting from want of knowledge, or care in the gathering and preparation of the drugs, or in the manufacture of chemicals, or from errors or carelessness in packing, storing and labelling; whilst the originally good quality may also have been lessened or destroyed by deterioration through moisture, exposure or age; and in chemicals also by incomplete or deficient methods of, or operations in, their manufacture, and through other accidental causes, and finally by fraudulent adulteration.

The methods employed for examination have been, in the case of crude and powdered drugs, a close and comparative inspection of their characteristic, physical properties and condition, their anatomical structure, etc., aided, whenever necessary, as particularly with powder and powdered drugs, by the use of a lens or of microscopes, and by comparison with microscopical standard preparations, as well as by chemical tests. With drugs, like wax and oil of cacao, well known empirical tests, resting mainly upon their greater or lesser solubility in solvents at certain temperatures, or upon other properties, have been used. For the examination of the chemicals, the most approved methods have been employed. Whenever required, or where different processes are applicable for the estimation of important chemicals, the one employed is indicated or described. A description, however, of the common and general chemical tests has been omitted, as such an elementary course would unduly enlarge this Report, would be superfluous to the expert and unavailing to the uninitiated, and would but be a written reproduction of what is stated in print in the Pharmacopœia, in "the National" and "the United States Dispensatories," and in Fr. Hoffmann's "Examination of Medicinal Chemicals."

As absolute purity in most medicinal chemicals and their pharmaceutical preparations is neither necessary, nor in many of them readily attainable, a certain margin has to be admitted and due allowance to be made, in all sharply defined chemical tests, for collateral and mostly insignificant and indifferent admixtures or remnants of solvents, or materials used or produced in the manufacture and preparation of chemicals. Traces of such co-incident impurities, therefore, are found and conceded in many commercial medicinal chemicals and their pharmaceutical preparations, but the experienced expert can readily and safely determine their amount and draw, with judicious discrimination, the proper line between the legitimate limit and the undue excess of any such impurity. * Their nature and character, moreover, have to be taken into

* This trust and privilege is likewise accorded to the expert pharmacist in countries where the practice of pharmacy is restricted by protective grants, and stands under the control of the National Government, and where, as for instance, in Germany, the most efficient measure to reach inferiorities and adulterations in drugs, consists in periodical inspections of the pharmacies and dispensing establishments. "This inspection is no dead letter, but is a severe, searching operation, performed, generally in one day, by a delegation nominated by the provincial government, and consisting of the department councillor of the provincial government (Regierungs Medicinalrath), the district physician and the district or some other delegated apothecary. One or more representatives of the local municipal authorities are also invited to attend the inspection. The drugs, especially those liable to deterioration or sophistication, and all pharmaceutical and chemical prepara-

special consideration whenever the impurity, or its amount and nature in any way may be objectionable, either by their powerful properties, or by their lessening or modifying the therapeutical value and effect of the chemical. The tests and the proper standard for relative purity in chemicals, therefore, have been applied throughout with due care, and with reasonable allowance where admissible and justified, but with strict discrimination whenever required by the kind and nature of both, the chemical and the impurity.

For all such chemicals and pharmaceutical preparations which admit and require, and for which the Pharmacopœia has established a standard strength on the basis of a specified or otherwise well known and recognized chemical assay, this test has, in general, to be applied as the principal criterion.

Crude Vegetable Drugs.

Seneca root, Root of Polygala Seneca, Linn. Twenty-three specimens Nos. 1106, 1133, 1174, 1215, 1263, 1312, 1315, 1383, 1423, 1440, 1478 1514, 1550, 1589, 1662, 1679, 1689, 1712, 1732, 558, 567, 585, 797. Eighteen specimens are true seneca root of good quality; 1 specimen (No. 1423) is the same but of inferior quality; 1 specimen (No. 1106) contains about fifty per cent of good and true root, the balance being inert rootlets, stolones of a graminea and some foreign root; 1 specimen (No. 1174) contains about seventy-five per cent of good root, the balance being some inert rootlets; 1 specimen (No. 1514) is seneca root of a poor and evidently inert quality; 1 specimen (No. 1440) is worthless on account of deterioration and adulteration.

Virginia snake root, Rhizome and rootlets of Aristolochia Serpentaria, Linn., and Aristolochia reticulata, Nuttal. Twenty-one specimens, Nos. 1107, 1134, 1175, 1216, 1264, 1316, 1349, 1384, 1441, 1424, 1479, 1515, 1551, 1590, 1627, 1663, 1680, 1699, 1713, 1733, 797. Twenty specimens are true Virginia snake root of fair quality; 1 specimen (No. 1216) are the rhizome and rootlets of Asarum canadense, Linn.

Sarsaparilla root, Root of Smilax officinalis. Humb. and Bonpl. Twenty-three specimens, Nos. 1108, 1135, 1176, 1217, 1295, 1317, 1350, 1385, 1425, 1442, 1480, 1516, 1552, 1591, 1629, 1665, 1682, 1700, 1715, 1735, 569, 585, 797. Nine specimens are true sarsaparilla root of good

tions of the Pharmacopœia are examined and their quality and strength tested. Store, laboratory, storage rooms and cellar are inspected. Not only are the drugs and the stock examined, but also the assistants and apprentices; they are required to show the certificates of their preliminary education and subsequent studies, are examined on the pharmaceutical sciences, on practical pharmacy, and the pharmacopœia, and have to submit to an inquiry into their studies, diligence and progress. The inspectors examine the apothecary's diploma, license, library, herbarium, prescription books and the prices charged on prescriptions. A resumé of the entire inspection is made and signed by all delegates and witnesses, and is sent to and kept by, the provincial government. From this the apothecary receives a report of the result of the inspection, with either acknowledging reflections, counsels for his or his assistant's benefit, or polite but precise and firm reprimands.

"The intercourse of the civil and judicial authorities with all citizens being dignified and polite, though strict, and regardless to position, means, rank or relations, the dealings of the authorities with the apothecaries are likewise characterized by consideration and respect. Like other professions, there is a great deal required from the apothecary, a high status of professional competency, fidelity and uncompromising reliability. In return the State grants him protection, and in ordinary life he enjoys, in common with the physician, the confidence and esteem of the community, by virtue of his vocation." (From "Pharmacy in Prussia and the German Empire by Fred. Hoffmann." American Journal of Pharmacy, Vol. 48, page 338.)

quality; 4 specimens (Nos. 1135, 1442, 1700, 569) contain more or less inert stolones of a graminea and rubbish; 2 specimens (Nos. 1715, 1735) are sarsaparilla root of a poor quality; 2 specimens (Nos. 1385, 1480) consist of inert rubbish; 1 specimen (No. 1295) consists of an inert substitute without containing any sarsaparilla root; 6 specimens (Nos. 1108, 1217, 1317, 1350, 1516, 1591) are altogether the rhizome of false sarsaparilla (Aralia nudicaulis, Linn).

Foxglove leaves. Leaves of Digitalis purpurea, Linn. Twenty-two specimens, Nos. 1136, 1177, 1218, 1266, 1351, 1378, 1386, 1443, 1481, 1426, 1517, 1553, 1593, 1630, 1666, 1683, 1701, 1716, 1736, 570, 587, 797. Twelve specimens are true foxglove leaves of satisfactory quality; 10 specimens (Nos. 1177, 1266, 1351, I481, 1517, 1630, 1666, 1736, 570, 587) are deteriorated by exposure and age.

Spanish saffron. The stigmas of Crocus sativus, Linn. Twenty specimens, Nos. 1110, 1138, 1178, 1219, 1268, 1319, 1352, 1427, 1445, 1483, 1555, 1595, 1631, 1684, 1718, 1738, 571, 572, 588, 797. Sixteen specimens, although called for and purchased as, and, except one specimen (No. 1738), labelled "Spanish saffron," are the florets of Safflower (Carthamus tinctorius, Linn); 3 specimens (Nos. 572, 588, 797) are true saffron of sufficiently good quality, the one (No. 572) containing some florets of Calendula officinalis, Linn.; 1 specimen (No. 571) is true saffron, but completely exhausted and consequently worthless.

Myrrh. The gum-resin of several species of Balsamodendron. Twenty-one specimens, Nos. 1179, 1111, 1139, 1220, 1269, 1320, 1353, 1389, 1428, 1446, 1519, 1484, 1556, 1596, 1632, 1676, 1694, 1709, 1719, 1741, 797. Fifteen specimens of more or less good quality; 2 specimens (Nos. 1111, 1139) powdered myrrh of apparently good quality; 4 specimens (Nos. 1320, 1353, 1428, 1519) myrrh of inferior quality.

White wax. Seventeen specimens, Nos. 1112, 1140, 1180, 1122, 1270, 1321, 1354, 1390, 1429, 1447, 1485, 1520, 1557, 1597, 1633, 1638, 797. Eleven specimens are pure wax; three specimens (Nos. 1180, 1354, 1429) contain some paraffine, and three specimens (Nos. 1633, 1638, 797) contain some stearin.

Two tests employed in the examination of wax were:

1. For *stearin.* About 5 grains of the finely scraped wax were dissolved in a dry test-tube in one fluid drachm of chloroform; the clear solution was subsequently agitated with two ounces of lime water (Hager's test).

2. For *paraffine.* Two drachms of the finely scraped wax were exhausted at a temperature of about 100° F. with two ounces of benzine; this dissolves little wax but all paraffine, if such be contained in the wax. The benzine solution was evaporated in a porcelain capsule, and the residue, if such a one of any amount was left, was treated with concentrated sulphuric acid, which destroys the small amount of wax dissolved, and leaves paraffine unchanged; where present this was recovered from the charred refuse by fusing it and by repeated washing with hot water while still molten.

Oil of Cacao. The fat of the seeds of Theobroma Cacao, Linn. Nineteen specimens, Nos. 1114, 1141, 1181, 1222, 1271, 1322, 1555, 1391, 1430, 1448, 1531, 1558, 1598, 1634, 1667, 1685, 1720, 1739, 797. Thirteen specimens are sufficiently pure oil of cacao; 6 specimens (Nos. 1181, 1271, 1355, 1391, 1598, 1667) contain more or less tallow or suet.

Björklund's test was employed. One drachm of the finely scraped oil of cacao was dissolved in a dry test-tube in two drachms of ether, taking care to replace the bulk of ether evaporated; when dissolved the test-tube was immersed into iced water; whilst pure oil of cacao separates completely in granules, the ether remains more or less turbid in accordance to the amount of other fats, generally tallow, if such are present as adulterants.

Quince seeds. The seeds of Cydonia vulgaris, Pers. Thirteen specimens, Nos. 1253, 1297, 1387, 1444, 1482, 1518, 1109, 1137, 1554, 1594, 1717, 1737, 797. Six specimens are quince seed of good quality, one specimen (No. 1137) is quince seed of poor quality, six specimens (Nos. 1297, 1554, 1594, 1717, 1737, 797) are largely adulterated with various admixtures.

Lycopodium. The sporules of Lycopodium clavatum, Linn. Fifteen specimens, Nos. 1143, 1273, 1324, 1323, 1373, 1450, 1459, 1560, 1600, 1677, 1695, 1710, 1722, 1737, 797, all true lycopodium of good quality.

Lupulin. The glands of the strobiles of Humulus lupulus, Linn. Eighteen specimens, Nos. 1144, 1184, 1224, 1274, 1325, 1357, 1394, 1432, 1451, 1487, 1524, 1561, 1601, 1635, 1696, 1723, 1743, 797. Eleven specimens are glands of good quality, one specimen (No. 1325) is of inferior quality, two specimens (Nos. 1524, 1696) contain an undue amount of powdered scales of the strobiles, and more or less of sand, three specimens (Nos. 1394, 1432, 1743) are worthless by deterioration, and also contain much of the powdered leaflets of the strobiles.

Arrow-root. The starch of the rhizome of Marantha arundinacea, Linn. Twenty specimens, Nos. 1115, 1142, 1182, 1223, 1272, 1323, 1354, 1392, 1431, 1449, 1486, 1522, 1559, 1599, 1635, 1668, 1686, 1721, 1740, 797. Twelve specimens are true arrow-root starch; two specimens (Nos. 1486, 797) contain some potato and corn starch; four specimens (Nos. 1142, 1323, 1635, 1721) contain much corn starch; one specimen (No. 1115) contains much corn and potato starch; one specimen (No. 1486) contains some potato starch; one specimen (No. 1559) contains largely corn and wheat starch.

POWDERED DRUGS.

The estimation of the purity and quality of most powdered vegetable drugs offers greater difficulties, since the methods for the detection of inferiorities and adulteration are less definite and established than is the case with unpowdered drugs, and since their adulteration consists not only in the admixture of cheaper foreign material, mostly starches, flour or cellulose of all kinds, but also and now pre-eminently, in the admixture of inferior brands of the same drug. The microscopical method of examination, therefore, has largely been made unavailing in recent years by shrewdly dispensing with the use of flour or starches as adulterants, once much practiced. Except such powdered drugs, which contain and whose therapeutical and commercial value rests mainly or wholly, on certain chemical constituents, and, therefore, can be ascertained in most of them, by chemical assay, as is the case with opium, cinchona bark and other drugs which contain alkaloids, pharmaceutical and chemical tests are either not applicable, or they are, for obvious reasons, unavailing or of questionable value, as, for instance, in powdered ipecac, whose percentage amount of pure emetia is both too small and too variable to

render a constant and reliable criterion; or in jalap, or other drugs containing resins or gum-resins, whose amount of soluble resin can readily be maintained by substitute in case of fraudulent exhaustion or adulteration. Empirical and comparative tests have, therefore, more or less to be resorted to for obtaining an approximately correct and reliable estimate of the quality of the powdered drugs, and these tests must be based and conducted, on a thorough knowledge of the physical characteristics of each drug and on a sufficient amount of skill, experience and unbiassed judgment of the expert.

Ipecac root. The root of Cephaelis ipecacuanha, Willd. Twenty-two specimens, Nos. 1127, 1147, 1211, 1227, 1278, 1310, 1329, 1360, 1397, 1435, 1454, 1490, 1507, 1565, 1604, 1638, 1646, 1669, 1689, 1704, 1726, 797. The specimens are all of good appearance, most of them rather too light in color and wanting in the characteristic odor and taste of best ipecac; a number of specimens (Nos. 1127, 1211, 1310, 1435, 1454, 1565, 1604, 1646, 1689, 1704) contain small admixtures of flour, or starch otherwise than that of ipecac.

Jalap root. The tuber of Exogonium purga, Benth. Twenty-two specimens, Nos. 1126, 1146, 1186, 1226, 1277, 1309, 1327, 1359, 1396, 1434, 1453, 1489, 1526, 1564, 1603, 1637, 1670, 1688, 1703, 1725, 1745, 797. The specimens are all of good appearance, but most of them are more or less wanting in the strength of the characteristic odor and taste of best jalap; a number of specimens (Nos. 1226, 1396, 1564, 1603, 1637, 1670, 1703, 1745) contain some admixture of flour or starch otherwise than that of jalap.

Orris Root. The rhizome of Iris florentina, Linn. Nineteen specimens, Nos. 1149, 1188, 1229, 1279, 1330, 1362, 1399, 1437, 1465, 1492, 1529, 1606, 1640, 1673, 1691, 1706, 1727, 1747, 797. Ten specimens are of good quality, four specimens (Nos. 1229, 1279, 1330, 1362) contain an admixture of corn starch; six specimens (Nos. 1399, 1606, 1673, 1706, 1727, 1747) contain evidently an admixture of some flour.

Rhubarb root. The root of species of Rheum. Twenty-three specimens, Nos. 1118, 1148, 1173, 1187, 1228, 1280, 1305, 1328, 1361, 1398, 1439, 1455 1491, 1528, 1566, 1605, 1672, 1690, 1705, 1730, 1739, 1750, 797. All specimens of good appearance, some of an unusual bright yellow color; one specimen (No. 1398) of inferior quality by exposure and age; five specimes (Nos. 1566, 1605, 1672, 1705, 1730) contain evidently admixtures of some flour or starch otherwise than that of rhubarb; one specimen (No. 1739) contains much admixtures of flour and starch.

Mustard seed. The powdered seed of Sinapis alba Linn. Twenty-four specimens, Nos. 1230, 1281, 1331, 1343, 1388, 1400, 1466, 1493, 1189, 1150, 1530, 1567, 1607, 1641, 1117, 1675, 1693, 1708, 1731, 577, 579, 598, 797, 578. Ten specimens are pure mustard; two specimens (Nos. 1117, 1150) the whole seed; twelve specimens (Nos. 1281, 1567, 1607, 173, 1577, 579, 598, 797, 1331, 1400, 1466, 1530) contain admixtures of more or less flour.

MEDICINAL CHEMICALS.

Benzoic acid. Seventeen specimens, Nos. 1121, 1151, 1190. 1231, 1282, 1332, 1364, 1401, 1494, 1531, 1404, 1569, 1609, 1643, 575, 593, 797. All specimens of good quality.

Citric acid. Fourteen specimens, Nos. 1152, 1191, 1232, 1283, 1333

1365, 1402, 1467, 1495, 1532, 1570, 1610, 1644, 797. All specimens true citric acid; most of them contain traces or more, of sulphuric acid resulting from insufficient purification in the manufacture.

Tannic acid. Eighteen specimens, Nos. 1129, 1153, 1192, 1233, 1284, 1334, 1344, 1364, 1403, 1468, 1496, 1533, 1571, 1611. 1645, 573, 592. All specimens of good quality

Gallic acid. Three specimens, Nos. 574, 594, 797. All specimens of good quality.

Sub-carbonate of bismuth. Twelve specimens, Nos. 1155, 1195, 1236, 1287, 1307, 1337, 1406, 1470, 1498, 1573, 1647, 797. All specimens of good quality.

Sub-nitrate of bismuth. Eighteen specimens, Nos. 1124. 1156, 1196, 1237, 1275, 1308, 1338, 1367, 1407, 1471, 1499, 1536, 1574, 1613, 1648, 584, 595, 797. All specimens of good quality.

Oxalate of cerium. Fourteen specimens, Nos. 1154, 1194, 1235, 1286, 1306, 1336, 1405, 1469, 1497, 1535, 1572, 1612, 1646, 797. All specimens of good quality.

Codeïa. Seven specimens, Nos. 1193, 1234, 1285, 1335, 1404, 1534, 797. All good codeïa, except one specimen (No. 1335) being sulphate of morphia, although labelled codeïa.

Iodine. Twenty specimens, Nos. 1131, 1159, 1199, 1240, 1290, 1340, 1369, 1474, 1410, 1411, 1471, 1502, 1536, 1538, 1539, 1577, 1590, 1616 1651, 797. All specimens of good quality.

Iodoform. Sixteen specimens, Nos, 1130, 1158, 1189, 1239, 1289, 1348, 1409, 1473, 1501, 1538, 1576, 1578, 1615, 1650, 797. All specimens of good quality.

Iodide of ammonium. Eleven specimens. Nos. 1200, 1241, 1291, 1370, 1411, 1475, 1503, 1540, 1578, 597, 797. Five specimens of iodide of ammonium of good quality; one specimen (No. 1291) damp; two specimens (Nos. 1200, 1540) yellow; three specimens (Nos. 1475, 1503, 1578) yellow and damp, from exposure.

Iodide of sodium. Three specimens, Nos. 1293, 1542, 797. All specimens of good quality.

Iodide of potassium. Seventeen specimens, Nos. 1125, 1191, 1201, 1242, 1292, 1341, 1371, 1412, 1476, 1504, 1541, 1579, 1617, 1652, 582, 596, 797. Fourteen specimens are of good quality, some (Nos. 1125, 1341, 1476) containing a little potassium carbonate, remaining from insufficient purification in manufacture. One specimen (No. 1579) contains a small admixture of bromide of potassium, whilst two specimens (Nos. 582, 596) are altogether bromide of potassium.

Cream of tartar. Fifteen specimens, Nos. 1116, 1162, 1202, 1243, 1294, 1342, 1372, 1413, 1477, 1505, 1543, 1581, 1618, 1653, 797. All specimens of good quality.

Saltpetre. Fifteen specimens, Nos. 1113, 1194, 1203, 1244, 1295, 1343, 1373, 1414, 1456, 1506, 1544, 1582, 1619, 1654, 797. All specimens, except three (Nos. 1441, 1456, 1582) in large crystals, are powdered or granular saltpetre of sufficient purity, the specimens in crystals are crude saltpetre and contain an undue amount of chlorides, of which only more or less traces are contained in the specimens in powder.

Tartar emetic. Fifteen specimens, Nos. 1120, 1163, 1204, 1246, 1294, 1344, 1374, 1415, 1457, 1507, 1545, 1583, 1620, 1655, 797. All specimens of sufficiently good qualtity.

Reduced iron. Seven specimens, Nos. 1119, 1157, 1197, 1238, 1288,

1408, 797. Five specimens of sufficiently good quality; two specimens (Nos. 1119, 1197) oxydized by age and exposure.

Carbonate of iron. Eight specimens, Nos. 1339, 1492, 1500, 1537, 1575, 1614, 1649, 797. All specimens of sufficiently good quality.

Nitrate of silver. Fifteen specimens, Nos. 1132, 1167, 1199, 1207, 1248, 1347, 1377, 1417, 1461, 1511, 1548, 1586, 1633, 1658, 797. All specimens in crystals of sufficiently pure quality.

Oxide of zinc. Fourteen specimens, Nos. 1169, 1209, 1259, 1306, 1348, 1379, 1421, 1463, 1513, 1550, 1588, 1625, 1666, 797. All specimens of sufficiently good quality.

Sulpho-carbolate of zinc. Six specimens, Nos. 1170, 1210, 1302, 1464, 1626, 797. Five specimens of good quality; one specimen (No. 1210) is altogether sulphate of zinc.

Santonin. Fifteen specimens, Nos. 1168, 1208, 1249, 1300, 1378, 1420, 1462, 1512, 1549, 1587, 1624, 1654, 559, 589, 797. All specimens sufficiently pure santonin; some have turned more or less yellow, by exposure to sun-light.

Sulphate of morphia. Sixteen specimens, Nos. 1165, 1128, 1205, 1246, 1297, 1304, 1345, 1375, 1416, 1458, 1508, 1546, 1584, 1621, 1656, 797. All specimens of good quality.

Muriate of quinia. Two specimens, Nos. 1509, 797. Both of good quality.

Sulphate of quinia. Nineteen specimens, Nos. 1123, 1166, 1209, 1247, 1298, 1346, 1376, 1418, 1460, 1510, 1547, 1585, 1622, 1657, 797, 599, 579, 580, 600. Two specimens (Nos. 580, 600) are altogether sulphate of cinchonidia; one specimen (No. 579) contains an undue amount of an admixture of lower cinchona alkaloids. The other specimens are of sufficient quality; they lose in drying at a temperature not exceeding 120° F., from 11 to 16 per cent of water of crystallization and moisture, and render all a more or less slight reaction of the lower cinchona alkaloids, with the pharmacopœial ether test.

In consideration of the fact that there are in the State of New York, according to reliable statistics, approximately not less than 2,800 drug-stores, and, besides, about 3,000 country and variety stores, where, among all sorts of merchandise, drugs and ready-made medicines are also vended, the number of specimens (659) obtained for the present examination represents a comparatively insignificant figure, altogether inadequate to serve for forming a correct inference, or an average estimate of, the quality and general character of drugs and medicines dispensed, at present, in our State. If, however, an opinion is desired on the basis and from the results of the present inquiry, it appears that the quality of medicinal chemicals dispensed in the few places wherefrom specimens have been provided, is a fair one, whilst this is less the case with the comparatively few specimens of crude vegetable drugs, as is particularly illustrated by the inferiority and substitution in such important remedies as digitalis, seneca, sarsaparilla, saffron, etc.

The specimens of powdered drugs, although mostly of good appearance, are evidently to a great extent, of unsatisfactory quality and questionable trustworthiness; many of them contain smaller or larger admixtures of starches or flour, and several, as for instance, ipecac, contain besides, when compared under the microscope, side by side, with standard preparations of the same drug, an undue amount of woody

fibre; many are more or less wanting in the strength of the characteristic odor and taste of the drug.

Powdered vegetable drugs, like many or most other pharmaceutical preparations, are not any more prepared by the pharmacists, and are generally bought bona fide. They unfortunately admit a wide scope for the disposal of commercial drugs of inferior, or deteriorated quality, as well as for adulteration, since the methods for the estimation of their purity and strength, as stated above, are less definite, and, with a few exceptions, rest mainly on the criterion of empirical tests.

In order to approximately realize the object of the present measure, and to secure a more commensurate and satisfactory estimate of the character and quality of drugs and medicines dispensed and vended for medication in our communities, a much more comprehensive and adequate collection of specimens, uniformly throughout all sections of the State, is necessary and should be organized. How to accomplish this in an efficient and at the same time, unobjectionable method, is a problem which offers no small difficulties and requires ampler grants for necessarily larger expenditures and increased labors. The present method appears to be at best, insufficient and unavailing, at least in respect to the collection of specimens of drugs and chemicals, and that the more so, as all the specimens collected by the appointed inspectors, for the present inquiry, were obtained from a few localities in only a few sections of the State.

This report would be incomplete if it would not take cognizance of that kind of modern medication whereby drugs and chemicals are largely and indiscriminately dispensed and consumed in the form of ready-made secret preparations, commonly known as patent medicines; they have rapidly increased in number, and have become of much importance as articles of commerce. The trade lists of secret and proprietary medicines embrace, at present, a much larger number of articles than all the legitimate preparations of the pharmacopœia, and, according to reliable statistics, it seems to be accepted as a fact, that presumably one-half of the medicinal drugs and chemicals consumed in the United States, enter into and are dispensed and consumed in, the form of secret and proprietary medicines. Large quantities of them are exported, whereas others of foreign make are imported. These medicines are vended everywhere in our State and country, without any restriction or control whatever, generally bearing upon their glaring wrappers and labels liberal medical advice, and pretensious claims as cure-alls for a long list of possible and impossible ailments, whilst they fail to add any statement about their composition, both in constituents and quantities.

Except the large class of so-called "Bitters," many of which are little more than whisky in disguise, nothing can be found out about these medicines from any established source of information. They stand outside of any authoritative recognition and control, are mostly made by irresponsible manufacturers and vended, beyond any responsibility, either of the maker or the retailer.

Much has been written about the extensive, indiscriminate and frequently reckless use and misuse, and the consequent injury and dangers of this kind of medications by medicines and preparations of unknown composition and qualities. A number of them have, from time to time, been analysed, and some have been found to contain potent drugs, the dispensation of which in such doses and for the specified purpose, or

the wide scope of application, would hardly be risked or approved in the practice of legitimate medication, while the nostrum-makers dispense them with the additional medical advice, unrestricted.

I deem it legitimate and proper, in conclusion, to briefly allude to this extensive and important trade in drugs and medicinal chemicals, which on account of its licentious and dangerous dispensation of potent drugs and medicines of unknown composition and qualities, under deceptive and unqualified names, advice and pretensions, remains as yet a problem among the needed sanitary reforms of our country.

Respectfully submitted,

FRED. HOFFMANN.

Group XI.

Gelatin and Sugar-coated and Compressed Pills of Quinine.

By George C. Caldwdll, Ph. D.

Quinine in Pills and Capsules.

Literature and Analysis.

Work on this part of my division was not begun till quite late in the fall, for reasons beyond my control. The literature of the subject is very scanty indeed, and it does not appear that the large quinine consuming public of this country has any assurance whatever that it gets its two, three or five grains of sulphate of quinine in the pills, capsules and other preparations said to contain these quantities.

For want of time to do more I have confined myself to the simple determination of the amount of quinine sulphate in the samples received; and have not attempted to ascertain the extent to which other alkaloids of the bark are substituted for it, to make up the deficiency when it exists. To this end I have proceeded as follows: a number of pills or capsules representing from eight to nine grains of the sulphate was put into a graduated tube holding about 60 cc., and digested in about 10 cc. of water acidified with sulphuric acid; complete solution of the entire substance of the pills was of course not always attained; but the quantity of acid added was amply sufficient to insure the solution of all the quinine. Ammonia was then added till the reaction was plainly alkaline, and thoroughly mixed with the liquid, and then about 40 cc. of ether; the tube was corked and its contents thoroughly shaken together as long as any further solution of the abundant white precipitate produced by the ammonia appeared to take place; the tube was then set aside for half an hour or till the ether became quite clear. Usually the aqueous liquid below the ether was simply slightly turbid; and the line of separation between it and the ether above was distinctly marked, but in some instances there was a glairy layer between, which in a very few cases occupied so much space that it was hard to estimate the real volume of the etherial solution; but in all such cases I gave to the pills the benefit of the doubt. To take off the ether solution I put in the place of the cork, another one carrying two tubes like those of an ordinary wash bottle, with the mouth of the longer tube opening just above the surface of the aqueous layer; the total volume of the etherial solution was noted, as well as of the small remainder left below the mouth of the exit tube; the solution was evaporated to dryness, the residue dried at 100°, the weight calculated for the whole volume of solution and multiplied by the factor 1,289 to get the corresponding weight of sulphate of quinine. Four tests of the process made with Powers and Wightman's sulphate of quinine proved it to be sufficiently accurate for the purpose in question.

According to *Van der Burg* (131) this extract may contain more than traces of quinidine if present in notable quantities. On the other hand *Sestini* (122) found it to be impossible to precipitate quinia completely with ammonia or potash. What with the possible partial compensation of these two errors by each other, and the fact that quinidia to some extent produces the same medicinal effect as quinia, although in a smaller degree, and the good results which I obtained with pure sulphate of quinine notwithstanding the difficulty which Sestini found, I think I am justified in considering that my results very fairly represent the quality of the samples received for examination.

The results are set forth in the following table; they show conclusively that the quantity of sulphate of quinine in pills and capsules usually falls short of the quantity claimed to be present by from 10 to 50 per cent.

Inspector's number.	Locality.	Stated contents of sulphate of quinine per pill in grains.	Contents found.		
			First trial.	Second trial.	Third.
510	New York city	2	1.7		
511	do	2	0.9		
1105	Jordan	2	1.3		
1171	Weedsport	2	1.6		
1172	do	2	1.8	1.7	
1212	Lyons	2	1.6		
1213	do	3	2.5		
1214	do	5	3.4		
1251	do	2	1.7		
1252	do	3	2.	2.4	
1254	Rochester	3	1.7	1.6	
1255	do	2	1.1	1.03	
1256	do	5	4.4	4.4	
1257	do	3	2.7		
1258	do	2	1.8		
1259	do	5	4.5		
1260	do	3	2.5		
1261	do	2	1.75	1.7	1.75
1262	do	2	1.7		
1303	Geneva	2	1.7		
1313	do	3	2.5		
1314	do	5	4.7		
1380	Herkimer	2	1.4		
1381	do	3	2.		
1382	do	5	2.4	2.1	
1422	Batavia	2	1.5		
1438	do	2	1.7		
1439	do	3	2.6		
1661	Norwich	3	2.8		

(131) Van der Burg. Fres. Zeitschr. 4, 1865, 276.
(122) Sestini. Fres. Zeitschr. 6, 1867, 362.

Not being satisfied with the results of the analysis of No. 1382, I requested Inspector Smith to procure another sample at the same place; it yielded 3.2 grains of sulphate of quinine per pill; but the dried residue of the etherial extract was evidently, from its appearance, not all quinine; it differed strikingly from the residue obtained with pure sulphate, and from the residue obtained with any other sample of pills examined. There was in the case of this sample as well as of numbers 1105 and 1422, a notable portion of the precipitate by alkali, that was insoluble in ether, indicating the presence in the pill of a quantity of some other alkaloid of the bark, doubtless either cinchonin or cinchonidine. The abnormal character of the residue of quinine, which was alike in all of the three analyses, indicates foreign matters, whose presence may account for the discordant results obtained in weight.

Fruit Essences.

The consideration of this subject was deferred till the other subjects included in my division, regarded as much more important, should have received due attention. Up to the time of the preparation of this report I have been unable to find opportunity to make any examinations of these substances, and I have only the following brief statement to offer.

The literature of the subject is exceedingly scanty. *Kletzinsky* (75a) gives recipes for the artificial preparation of the essences; the materials used are alcoholic solutions of ethyl acetate, formiate, butyrate, valerianate, œnanthate, benzoate, sebacate and salicylate; amyl acetate, butyrate and valerianite; of tartaric, succinnic, oxalic and benzoic acids, aldehyd and glycerine. Inspector Colby obtained from a leading druggists' firm in New York city several recipes, some of which are essentially the same as those given by Kletzinsky, with the addition, when the essence is to be colored, of tincture of safflower or sandalins, or of aniline red (free from arsenic). The inspector was informed that *genuine natural fruit essences are not in the market. Hager* (54) calls attention to the fact that although there are tests for the detection of these artificial essences, they are still sold; and he gives again certain reactions by which artificially colored imitations of red fruit essences can be detected.

Respectfully submitted,
G. C. CALDWELL.

CORNELL UNIVERSITY,
December, 1881.

(75a) Kletzinsky. Dingl. Pol. Jour. 153, 1859, 407; Bulletin Soc. Chimique, 6, 1866, 473, Wurtz, Dict. de Chimie, T. 1.
(54) Hager. Fres. Zeitschr. 10, 1871, 284.

Group XII.

Effervescing Medicinal Preparations.

By Willis G. Tucker, M. D., Ph. D.

To Prof. C. F. Chandler, *Chairman of Sanitary Committee:*

Under the head of "effervescing medicinal preparations" are included a large number of effervescing salts and compounds, many of which, however, are but little known and have but a limited sale. It was therefore deemed best to make an examination first of the two most important officinal preparations belonging to this class, both of them being well known and highly popular remedies which have long been largely sold and commonly employed, namely the Seidlitz Powders (*Pulveres effervescentes aperientes*, U. S. P.) and the Solution of Citrate of Magnesium (*Liquor Magnesii Citratis*, U. S. P.) The sales of these two preparations in this State probably largely exceed those of all other effervescing preparations (used strictly as medicines) combined. Estimates were obtained from both wholesale dealers and manufacturers of the amount and value of these preparations sold *per annum* in this State but they differed widely and are not here stated. It is well known, however that they are very extensively sold, being largely prescribed by physicians and commonly employed as household remedies.

I. Seidlitz Powders.

These are officinal, having been introduced into the Pharmacopœia of 1850, and continued since.

Composition, etc. One powder, commonly enclosed in a white paper, contains 35 grains of powdered tartaric acid and the other, commonly wrapped in blue paper, contains an intimate mixture of 40 grains of bi-carbonate of sodium and 120 grains of the double tartrate of sodium and potassium or "Rochelle salt." When the contents of the two papers are separately dissolved in water and the solutions mixed the chemical reaction which takes place results in the formation of the neutral sodic tartrate and the liberation of carbonic acid gas, which aerates the mixture, while the Rochelle salt is unchanged. The proportions in which these substances are directed to be employed are almost exactly those which insure the complete decomposition of the bi-carbonate, the chief use of which is to render the mixture effervescent, while the Rochelle salt, a gentle purgative, is the chief medicinal ingredient, although the sodic tartrate produced by the decomposition of the bi-carbonate, is not entirely inert. It is therefore seen that these proportions should be preserved, and that if they be widely departed from the powders become less valuable, inert or even harmful. Thus if the Rochelle salt be reduced in quantity while the amount of the bi-carbonate is increased without at the same time increasing the amount of tartaric acid, the medicine as administered consists largely of undecomposed bi-carbonate of sodium, so that instead of furnishing an aerated solution of neutral purgative salts, it consists largely of the alkaline bi-carbonate possessing no value as a cathartic and perhaps even operating injuriously.

Chief sophistications. Since the cost of Rochelle salt varies from 32 to 36 cents per lb. and that of the bi-carbonate of sodium but from four to six cents per lb. it is a not unusual practice to diminish the quantity of the former and increase that of the latter ingredient.

Some slight variation from the correct standard there will generally be since it is exceedingly difficult intimately to mix the two substances so as to render the composition of a batch of the powder perfectly uniform, but this mixture should be accomplished by proper machinery if the powders are made on a large scale and the proportions of the two ingredients ought not to vary far from the correct ratio of one to three.

Aside from this unwaranted alteration, powders are frequently sold which fall below the officinal weights. Slight errors will of course occur because these powders are ordinarily measured and not weighed but the variation ought not to be large.

Collection of samples for analysis. Seventy-two powders were examined of which 35 were received from New York from Mr. A. L. Colby, Inspector to the Board, and 37 were collected in Albany and vicinity.

Of those obtained in Albany and vicinity, one was sent to me by the Secretary of the Board, nine were collected in Albany by myself, ten in Albany by Mr. Ladue, a student of mine, at my request, and the remainder (17) by Mr. Ladue in Troy, West Troy, Green Island and Cohoes. All were properly recorded and numbered and in each case the portion remaining unused was bottled and preserved. These samples probably represent rather the better class of powders sold.

Examination—average weight. (1) *Tartaric acid.* The average weight of the samples received from New York, was 42.6 grains, being 7.6 grains above the prescribed weight. Of these, 5 were of the correct weight, 6 were under weight and 24 were over weight, the smallest powder weighing 25 grains and the largest 60 grains.

The average weight of the samples obtained in Albany and vicinity was 35 grains, being the correct amount, but of 36 samples only five were of correct weight, 18 being under weight and 13 over weight. The smallest weighed 18 grains and the largest 56 grains. The average weight of 71 samples was 38.7 grains. It seems probable that the amount of tartaric acid is often purposely increased for the sake of decomposing the excess of the bi-carbonate employed in the seidlitz mixture.

(2) *The seidlitz mixture.* The average weight of 35 samples obtained from New York was 162.5 grains or 2.5 grains over weight. The variation was considerable, not one weighing exactly 160 grains; 14 were under weight and 21 over weight, the smallest weighing only 90 grains, and the largest 206 grains.

Of the 36 samples collected in Albany and vicinity (one of the 37 being in bulk) the average weight was 143.7 grains, or about 11 per cent. below the prescribed weight; four only were of correct weight, 21 being under weight, and 11 over weight. The smallest weighed 63 grains and the largest 225 grains. The average weight of 71 samples was 153.1 grains.

Chemical examination. A qualitative examination was first made of each powder. The contents of the white paper was proved in every instance to be tartaric acid of good or fair quality. Almost all the samples showed, as would naturally be expected, traces of sulphates and varying traces of lead.

The "seidlitz mixture" contained in the blue papers was found in but three instances to be other than a mixture of Rochelle salt and soda. In one of these, labelled "Seidlitine" sugar was added; a second contained a considerable quantity of the di-sodic carbonate and in the third the soda was omitted entirely, probably through mere carelessness. No make-weight nor any gross adulterant was detected in any of the powders save as here stated. The majority showed varying traces of sulphates, but in no instance was sulphate of soda found in such quantity as to indicate its intentional addition as an adulterant, as is said frequently to be the case, both with Rochelle salt and "seidlitz mixture." Traces of chlorides were generally present and also of lead in varying traces. Di-sodic carbonate was present in small quantity in five samples and in large quantity in one, as stated.

Quantitative estimation of hydro-sodic carbonate in the Seidlitz mixtures.

This was determined by estimating the carbonic di-oxide in about four grammes of each powder by Fresenius and Will's method and in case a qualitative examination had shown no other constituent in decided quantity than soda and Rochelle salt, the amount of the latter was determined approximately by subtracting from the weight of the powder taken the weight of the soda calculated. The ratio was then determined by dividing the weight of the Rochelle salt thus obtained by the weight of soda present. Since good articles of commercial bi-carbonate were found to yield from 94 to 97 per cent. of real hydro-sodic carbonate five per cent. was added to the amount of this constituent calculated.

Results. Thirty-five samples from New York gave a ratio of soda to Rochelle salt of 1 : 2.49, while 35 from Albany and vicinity gave a ratio of 1 : 2.63, the correct officinal proportion being 1 : 3. The average of 70 samples was 1 : 2.56. Calling a variation in the proportion, of Rochelle salt to soda, of from 2.8 to 3.2 of the former to one of the latter as fairly allowable we find that in the 70 samples examined 35, or 50 per cent., fell below the ratio of 2.8 : 1, the lowest ratio being 1.05 : 1 or nearly equal parts of each constituent. 31 or 44 per cent. gave a ratio of between 2.8 and 3.2 to one and only 4 of over 3.2 to one, clearly showing that this variation is by no means accidental, but evidently the result of an intentional alteration in the proportions of the ingredients employed.

Conclusions concerning Seidlitz Powders.

(1) Make-weights and gross adulterants are probably uncommon since they were detected in but 2 out of 72 samples.

(2) The weights of both the acid and seidlitz mixture showed a great diversity, being in some instances less than half, and in others nearly twice the correct amounts. Nevertheless the average of the 72 samples was in the case of the acid above the officinal amount, while in the case of the seidlitz mixture it was about 5 per cent below. These variations are undoubtedly due in many instances merely to careless measuring instead of careful weighing, but in many other instances the powders are undoubtedly manufactured of short weight.

(3) The ratio in which the constituents were present in the seidlitz mixtures was in at least one-third the samples too low to be accounted

for save by intentional decrease in the amount of Rochelle salt and increase in the amount of soda. Such a disproportion annuls or materially lessens the efficacy of the powders for the purpose intended.

II. Solution of Citrate of Magnesium.

This is also an officinal preparation, having been introduced into the Pharmacopœia of 1850,. and continued in those of '60 and '70, the formula having been changed in each instance. The preparation is a highly popular one and is largely sold, more particularly in cities and large towns. To be "officinal" it should be prepared by the process prescribed in the pharmacopœia of 1870, although this, like those which had preceded it, is open to some objections, the chief being that after standing for same time the solution deposits a granular precipitate of magnesic citrate. Probably this difficulty cannot be obviated except by diminishing the amount of carbonate of magnesium employed in its manufacture.

Sophistications. In order to obtain a clear, unalterable, saleable solution and also to lower the cost of manufacture, an effervescing solution of sodium tartrate, made in various ways, sweetened with simple syrup and flavored with essence of lemon to simulate the real citrate, is frequently sold in its stead and under its name.

Collection of samples. Nine samples were received from Mr. Colby, having been collected in New York city. Five samples were purchased for me by Mr. Ladue in Troy, West Troy and Cohoes.

Chemical analyses. These, owing to lack of time on my part, were kindly made for me by my friend and colleague, Dr. Maurice Perkins, Professor of Chemistry in Union College.

Results. Of the 9 samples received from New York, 6 contained magnesic citrate, potassic citrate (potassic bi-carbonate being added in bottling and just before corking, to cause effervescence) and free carbonic acid. These contained no tartaric acid and may be considered genuine; 3 consisted mainly of a solution of sodic tartrate and contained no magnesia nor citric acid. Quantitative determinations of most of the constituents were made.

Of the 5 samples obtained in Troy and vicinity, 2 consisted of a solution of magnesic citrate, etc., and were considered genuine, while 3 were solutions of sodic tartrate and contained no magnesia nor citric acid. Of the 14 samples examined 6 were therefore spurious, from which it would appear that the preparation sold under the name of the "Solution of Citrate of Magnesium" is frequently sophisticated.

Respectfully submitted,

W. G. TUCKER.

Laboratory Albany Medical College, Albany, *December*, 1881.

NOTE.— In closing this series of reports of the first few months' results of work performed by the Analysts of Food and Drugs under the new law, the Chairman of the Standing Committee having supervision of these duties has been constrained to postpone his separate report upon GROUP I,— Milk,— until the second series of reports by the analysts is called for by the Board. Yet in his general statements relating to the organization and progress of duties under the new Law, he has presented important facts which show in what directions his investigations of Milk questions are progressing. (See pages 501, 502 and 503.) The urgency of duties in the general supervision of chemical work for this Board, added to other labors, has merely deferred the completion of Prof. Chandler's separate report upon GROUP I.

It is found necessary, also, to defer the printing of the reports upon the Hygiene of Tenement Houses, the West Troy Water-supply, the present state of evidence relating to Small-pox and Vaccination, and the production of Bovine Virus, and the description of the Malarial Regions in the State. All of these papers comprise illustrations and the results of much careful investigation. They will appear in the Board's Third Report.

E. M. MOORE, *President.*
ELISHA HARRIS, *Secretary.*

[No. 40.]

State Board of Health of New York.

BUREAU OF CHEMICAL ANALYSIS TO PREVENT ADULTERATION OF FOOD AND DRUGS.

CATALOGUE

OF

THE LITERATURE OF THE CHEMISTRY OF FOOD AND DRUGS.

Prepared by Albert L. Colby, Ph. B.

A Catalogue for the use of the Analysts and Inspectors under the State Board of Health of New York.

I. GENERAL WORKS.

1. FOOD AND DRINK.

Journals Relating to the Adulterations of Food and Drink, and their Detection.

Proceedings of the Society of Public Analysts. 8vo. 248 pp. Vol. I. London, 1876. Now merged into the Analyst.

The Analyst, including the Proceedings of the Society of Public Analysts. London. 8vo. Monthly. Vols. I–VI. 1877 to date. This is the official journal of the Society of Public Analysts of Great Britain. It contains a full report of their proceedings, and gives the latest intelligence in regard to the methods of detecting adulterations.

The Food Journal. London. 8vo. Monthly. 4 vols. 1870–1874.

Food, Water, and Air, in Relation to the Public Health. Conducted by Arthur Hill Hassall. London. Quarto. Monthly. Vol. I. 1872– ——.

The Sanitary Engineer. Vols. I–IV. New York. 1877 to date (weekly since 1882).

Jacobsen, E.: Chemisch-technisches Repertorium. Mittheilgn. d. neuesten Erfindgn. u. Fortschritte auf d. Geb. d. techn. u. industr. Chemie. Jahrg. 1862–78 u. Register üb. Jahrg. 1–15. 1862–80.

Zeitschrift f. Untersuchung von Lebensmitteln u. Verbrauchs-Gegenständen. Hrsg. v. Biechele. Jahrg. I–III. 1878 bis 1880.

Repertorium der Analytischen Chemie: für Handel, Gewerbe und öffentliche Gesundheitspflege. Organ des Vereins analytischer Chemiker. Erster Jahrgang, 1881.

Schäfer, Th.: Wider die Nahrungsfälscher: Zeitschrift. **Organ des Untersuchungsamtes** für Lebensmittel etc. Hanover, 1878.

Zeitschrift für Analytische Chemie. Dr. C. Remigius Fresenius. Wiesbaden. 8vo. Quarterly. Vols. I–XX. 1862 to date.

English Parliamentary Reports Relating to the Adulterations of Food and Drink, and their Detection.

First Report from Select Committee on Adulteration of Food, etc., with Minutes of Evidence and Appendix. 1855.

Second Report from Select Committee on Adulteration of Food, etc., with Minutes of Evidence and Appendix. 1855.

Index to Reports from Select Committee on Adulteration of Food, etc., with Minutes of Evidence, Appendix, and Index. 1856.

Report from Select Committee on Adulteration of Food, etc. 1872. With Minutes of Evidence and Appendix. 1874.

Monograph Volumes Relating to the Adulterations of Food and Drink, and their Detection.

[*Arranged According to Date of Publication.*]

Accum, Frederick: A Treatise on Adulteration of Food and Culinary Poisons. 8vo. Pp. 344. London, 1820. This work is mainly interesting as being the first attempt, in English, of a systematic presentation of the subject. It is generally referred to as "Death in the Pot," from the wood-cut on the title page.

Cutbush: Lectures on the Adulteration of Food and Culinary Poisons. Newburg, 1823.

Pereira, Jonathan, M. D.: A Treatise on Food and Diet, with observations on the dietetical regimen suited for disordered state of the digestive organs, etc. 8vo. 542 pp. London, 1843.

Garnier: Des falsifications des substances alimentaires, et des moyens de les reconnaître. Paris, 1844.

Beck, Lewis C., M. D.: Adulterations of Various Substances used in Medicine and the Arts. 8vo. 322 pp. New York, 1846.

Duflos, Dr. Adolf: Die wichtigsten Lebensbedürfnisse, ihre Aechtheit und Güte, Verunreinigungen, Verfälschungen, etc. 8vo. 390 pp. Breslau, 1846.

Mitchell, John: Treaties on the Falsification of Food. 8vo. 330 pp. London, 1848.

Moleschott, Jac.: Lehre der Nahrungsmittel für das Volk. 8vo. 256 pp. Erlangen, 1853.

Hassall, Arthur Hill, M. D.: Adulterations detected in Food and Medicine. 1st edition. London, 1854. This work is out of print and very difficult to obtain. The engravings, being the first impressions from the blocks, are much sharper than in later editions.

Bureaux: Histoire des falsifications des substances alimentaires. Paris, 1855.

Fop: Adulteration of Food. London, 1855.

Hassall, Arthur Hill, M. D.: Food and its adulterations, comprising the reports of the Analytical Sanitary Commission of the Lancet, for the years 1851–1854, inclusive, revised and enlarged. Illustrated by 159 engravings. 8vo. 659 pp. London, 1855.

How: Adulteration of Food and Drink. London, 1855.

Klencke, Dr.: Die Nahrungsmittelfrage in Deutschland. 8vo. 173 pp. Leipzig, 1855.

Chevalier: Dictionnaire des altérations et falsifications des substances alimentaires, médicamenteuses et commerciales, avec l'indication des moyens de les reconnaître. Paris, 1856.

Dodd, Geo.: The Food of London. 8vo. 524 pp. London, 1856.

Marset: Composition, Adulteration, and Analysis of Food. London, 1856.

Payen: Substances alimentaires. Paris, 1856.

Dalton: Adulteration of Food. London, 1857.

Klencke, Hermann: Die Verfälschung der Nahrungsmittel und Getränke, etc. 8vo. 1099 pp. Leipzig, 1858.

Petit, Lafitte: Instruction simplifiée pour la constatation des propriétées des altérations et des falsifications des principales denrées alimentaires. Bordeaux, 1858.

Friedrich: Die Verfälschung der Speisen und Getränke. Münster, 1859.

Gerhardt: Précis d'Analyse pour la recherche des altérations et falsifications des produits chimiques et pharmaceutiques. Paris, 1860.

Brinton, William, M. D.: On Food and its Digestion, being an introduction to Dietetics. 8vo. 485 pp. London, 1861.

Hassall, Arthur Hill, M. D.: Adulterations detected in Food and Medicine, or plain instructions for the Discovery of Frauds in Food and Medicine. 8vo. 712 pp. 2d edition. London, 1861.

Haskins, T. H., M. D.: What we eat, and an account of the most common adulterations of food and drink, with simple tests by which many of them may be detected. 8vo. 218 pp. Boston, 1861.

Muller, A.: La composition chim. d'aliments représ. en tableaux coloriés. Brux., 1862.

Normandy, A.: The Commercial Hand-Book of Chemical Analysis. 8vo. 640 pp. London, 1865.

Lancaster, Edwin, M. D.: Good Food, What it is, and How to get it. 8vo. 64 pp. "Household Manual." London, 1867.

Cameron, C. A.: Chemistry of Food. London, 1868.

Letheby, H.: On Food, its varieties, chemical composition, nutritive value, comparative digestibility, physiological functions and uses, preservation, adulteration, etc., being the substance of Four Canton Lectures. 8vo. 277 pp. London, 1870.

Cameron, C. A.: A handy book on Food and Diet in health and disease. London, 1871.

Dobell, Horace, M. D.: On Diet and Regimen in sickness and health. 5th edition. London, 1872.

Letheby, H., Ph. D.: On Food, its varieties, chemical composition, nutritive value, comparative digestibility, physiological functions and uses, preparations, culinary treatment, preservation, adulteration, etc. 8vo. 255 pp. 2d edition. New York, 1872.

Vogel, A.: Nahrungs- und Genussmittel aus dem Pflanzenreiche. Wien, 1872.

Hager, H.: Untersuchungen. Handbuch d. Untersuchgn., Prüf. u. Werthbestimmung aller Handelswaaren, Natur- u. Kunsterzeugnisse. Leipzig, 1873.

Lancaster, E.: On Food. 2d edition. London, 1873.

Parkes, Dr. E. A.: Practical Hygiene. Edited by F. S. B. François de Chaumont, M. D. 8vo. 733 pp. 5th edition. Philadelphia, 1878. Contains two chapters on Food, Beverages, and condiments, with modes of detecting adulterations; numerous wood-cuts.

Smith, Edward: Hand-book for Inspectors of Nuisances. Contains full text of English laws on food and its adulteration. London, 1873.

Smith, Edward: Foods. London and New York, 1873.

Atcherly, Rowland J., Ph. D.: Adulterations of food, with short processes for their detection. 8vo. 112 pp. London, 1874.

Baltzer, L.: Die Nahrungs- und Genussmittel der Menschen in ihrer chem. Zusammensetzung und physiolog. Bedeutung. Nordhausen, 1874.

Lunel: Guide pratique pour reconnaître les falsifications et altérations des substances alimentaires. Paris, 1874.

Marvaud, A.: Les aliments d'épargur. 2e édition. Paris, 1874.

Pavy: Food and Dietetics. London and Philadelphia, 1874.

Smith, Edward: Manual for Medical Officers of Health. Contains full text of English laws on food and its adulteration. London, 1874.

Springer, Julius: Ein Handbuch der Untersuchung, Prüfung und Werthbestimmung aller Handelswaaren, Natur- und Kunsterzeugnisse, Gifte, Lebensmittel, Geheimmittel, etc. 8vo. Berlin, 1874.

Soubeiran, J. Léon. Nouveau Dictionnaire des falsifications et des altérations des aliments, des médicaments, etc. 8vo. 634 pp. Paris, 1874.

Thiel, Dr. Carl Eugen: Nahrungs- und Genussmittel als Erzeugnisse der Industrie. 8vo. 198 pp. Braunschweig, 1874.

Dammer: Kurzes chem. Handwörterbuch. 1875.

Muller, A.: Chem. Zusammensetzung d. wicht. Nahrungsmittel. 4. A. 1875.

Normandy: Edited by Noad. The Commercial Hand-book of Chemical Analysis. London, 1875.

Smith, Ed.: Die Nahrungsmittel. 2 Thle. Leipzig, 1875.

Walchner: Die Nahrungsmittel des Menschen, ihre Verfälschungen und Verunreinigungen. Berlin, 1875.

Blyth, A. Wynter: Dictionary of Hygiene and Public Health. London, 1876.

Bolley: Handbuch der technisch-chemischen Untersuchungen. 4te Auflage, ergänzt und bearbeitet von Prof. Dr. Kopp. Large 8vo. Leipzig, 1876.

Hassall, Dr. Arthur Hill: Food; its Adulterations and the Methods for their Detection. Illustrated by upwards of 200 wood engravings. 8vo. 896 pp. London, 1876.

Naquet, A.: Legal Chemistry. Translated by J. P. Battershall. This work contains a very full bibliography of works relating to the subjects of foods and poisons. 8vo. 178 pp. New York, 1876.

Atcherly, Rowland F.: Adulterations of Food. London, 1877.

Bauer, Max: Die Verfälschung der Nahrungsmittel in grossen Städten, speciell Berlin und die Abhülfe dagegen vom gesetzlichen, gesundheitlichen und praktischen Gesichtspunkte. 8vo. 136 pp. Berlin, 1877.

Birnbaum, K.; Einfache Methoden zur Prüfung wichtiger Lebensmittel auf Verfälschungen. Karlsruhe, 1877.

Chevallier, A., et **E. Baudrimont**: Dictionnaire des altérations et falsifications des substances alimentaires, médicamenteuses et commerciales, avec l'indication des moyens de les reconnaître. 8vo. 5th edition. Paris, 1877.

Focke, Ed.: Massregeln gegen Verfälschung der Nahrungsmittel. Chemnitz, 1877.

Hausner, A.: Die Fabrication d. Conserven u. Conditen. Leipzig, 1877.

Kensington: Analysis of Foods. This is quite a full collection of the analyses of various kinds of food. London, 1877.

Löbner, A.: Massregeln gegen Verfälschung der Nahrungsmittel. Chemnitz, 1877.

Mierzinski, Lt.: Die Conservirung d. Thier- u. Pflanzenstoffe (Nahrungsmittel, etc.). Berlin, 1877.

Schnacke, Georg: Wörterbuch der Prüfungen verfälschter, verunreinigter und imitirter Waaren, mit Angabe d. Wesens und der Erkennung der Aechtheit der Waaren. Jena, 1877.

Averbeck, H.: Die Verfälschungen d. Nahrungs- und Genussmittel. Bremen, 1878.

Dietzsch, O.: Die wichtigsten Nahrungsmittel u. Getränke, deren Verunreinigungen u. Verfälschungen. 3. A. Zürich, 1878.

Elsner, Fr.; Untersuchgn. v. Lebensmitteln u. Verbrauchsgegenständen. 1878.

Fox, C. B.: Sanitary Examinations of Water, Air, and Food. London, 1878.

Klencke, Dr. Hermann: Illustrirtes Lexicon der Verfälschungen der Nahrungsmittel und Getränke. 8vo. Leipzig, 1878.

Schmid, Dr. Werner: Anleitung zu sanitärisch- und polizeilich-chemischen Untersuchungen. 8vo. 192 pp. Zürich, 1878.

Wittstein, G. C.: Taschenbuch der Nahrungs- und Genussmittel-Lehre. 8vo. 176 pp. Nördlingen, 1878.

Allen, Alfred H.: Commercial Organic Analysis. Vol. I. Cyanogen compounds, alcohols, and their derivatives. Phenols, acids, etc. 8vo. 360 pp. Philadelphia, 1879.

Blyth, A. Wynter: A Manual of Practical Chemistry; the Analysis of Foods and Detection of Poisons. 8vo. pp. 468. London, 1879.

Bolley; Handbuch der technisch-chemischen Untersuchungen. Large 8vo. Latest edition. Leipzig, 1879.

Caldwell, Prof. G. C.: Agricultural Qualitative and Quantitative Chemical Analysis. 8vo. 307 pp. New York, 1879.

Dietzsch, Oscar: Die wichtigsten Nahrungsmittel und Getränke, deren Verunreinigungen und Verfälschungen. 8vo. 252 pp. Zürich, 1879.

Hilger, A.: Die wichtigsten Nahrungs- u. Genussmittel. Erl., 1879.

Post, Dr. Jul.: Grundriss der chemischen Technologie. 8vo. 709 pp. Berlin, 1879.

König, Dr. J.: Chemie der menschlichen Nahrungs- und Genussmittel. 1st part. 8vo. pp. 248. Berlin, 1879. 2d part. 8vo. pp. 620. Berlin, 1880.

Squibb, Edward R.: Proper Legislation on the Adulteration of Food and Medicine. 8vo. —— pp. New York, 1879.

Elsner, Dr. Fritz: Die Praxis des Nahrungsmittel-Chemikers. Anleitung zur Untersuchung von Nahrungsmitteln und Gebrauchsgegenständen, sowie für hygienische Zwecke. 8vo. 180 pp. Leipzig, 1880.

Griessmayer, Dr. Victor: Die Verfälschung der wichtigsten Nahrungs- und Genussmittel vom chemischen Standpunkte in populärer Darstellung. 8vo. 119 pp. Augsburg, 1880.

Gruckeisen, A.: Die modernen Principien d. Ernährung nach v. Pettenkofer u. Voit. Köln, 1880.

Johnston, James F. W.: The Chemistry of Common Life. 8vo. 592 pp. New York, 1880.

Medicus, Dr. Ludwig: Gerichtl.-chem. Prüfung von Nahrungs- u. Genussmitteln. Würzb., 1880.

Pick, S.: Die Untersuchung d. im Handel u. Gewerbe gebräuchlichsten Stoffe, einschliesslich d. Nahrungsmittel. Wien, 1880.

Pratt, J. T.: Food Adulteration, or what we eat and what we should eat. 8vo. Chicago, 1880.

Schnacke, Dr.: Die Prüfung verfälschter, verunreinigter und imitirter Waaren nach alphabetischer Ordnung der letzteren. Ein Waaren-Wörterbuch. 8vo. Leipzig, 1880.

Blochmann, R.: Ueber Verfälschung der Nahrudgs- und Genussmittel etc. Large 8vo. 56 pp. Königsberg, 1881.

Flügge, Dr. C.: Lehrbuch der hygienischen Untersuchungsmethoden. 8vo. 602 pp. Leipzig, 1881.

Post, Dr. Jul.: Handbuch der analytischen Untersuchungen zur Beaufsichtigung des chemischen Grossbetriebes. 8vo. 528 pp. Braunschweig, 1881.

2. DRUGS.

Journals Relating to the Adulterations of Drugs and Medicine, and their Detection.

American Journal of Pharmacy. Published by authority of the Philadelphia College of Pharmacy. Edited by John M. Maisel. 8vo. Vols. I to LIII. 1828 to date.

Archiv f. Pharmacie. Zeitschrift d. deutsch. Apotheker-Vereins. Bd. 216, 217, Jahrg. 1880.

Centralhalle, Pharmaceut. Zeitung f. wissenschaftl. u. geschäftl. Interessen d. Pharmacie. Hrsg. v. Hager. Jahrg. 1–21. 1859–1880.

Jahresbericht über die Fortschritte der Pharmacognosie. Hrsg. v. Dragendorff. Jahrg. 1–38 f. 1841–78. 1843–79.

Proceedings of the American Pharmaceutical Association. 8vo. Vols. I–XXVIII. 1851 to date.

Zeitschrift, Pharmaceut. Central-Organ f. d. gewerbl. u. wissenschaftl. Interessen d. Pharmacie u. verwandter Berufs- u. Geschäftszweige. Hrsg. v. H. Müller. Jahrg. 14–26, 1869–81.

Monograph Volumes Relating to the Adulterations of Drugs and Medicines, and their Detection.

[*Arranged According to Date of Publication.*]

Pierce, C. H.: Examinations of Drugs and Medicines. Phila., 1853.

Hassall, Arthur Hill, M. D.: Adulterations detected in Food and Medicine. 1st edition. London, 1854. This work is out of print and very difficult to obtain. The engravings, being the first impressions from the blocks, are much sharper than in later editions.

Rochleder, Friedrich: Anleitung zur Analyse von Pflanzen und Pflanzentheilen. 8vo. 112 pp. Würzburg, 1858.

Hassall, Arthur Hill, M. D.: Adulterations detected in Food and Medicine. 8vo. 712 pp. 2d edition. London, 1861.

Berg: Anatomischer Atlas zur pharmaceutischen Waarenkunde. 4to. Berlin, 1864.

Henkel, Dr. I. B.: Die Merkmale der Aechtheit und Güte der Arzneistoffe des Pflanzen- und Thierreichs, nebst Anleitung zur Prüfung derselben auf ihren Gehalt an wirksamen Bestandtheilen. 8vo. Tübingen, 1864.

Wittstein, G. C.: Taschenbuch der Geheimmittellehre. 8vo. Nördlingen, 1867.

Wittstein, Dr. G. C.: Anleitung zur chemischen Analyse von Pflanzen und Pflanzentheilen auf ihre organischen Bestandtheile. 8vo. 355 pp. Nördlingen, 1868.

Duflos, Adolf: Handbuch der angewandten pharmaceutisch- und technisch-chemischen Analyse. 8vo. 432 pp. Breslau, 1871.

Hager, Dr. Hermann; Untersuchungen. Ein Handbuch der Untersuchung, Prüfung und Werthbestimmung aller Handelswaaren. Vol. I. 8vo. 635 pp. Vol. II. 8vo. 647 pp. Leipzig, 1871.

Hoppe-Seyler, F.: Medicinisch-chemische Untersuchungen. 8vo. 593 pp. Berlin, 1866–71.

Fluckiger; Grundlagen der pharmaceutischen Waarenkunde. Einleitung in das Studium der Pharmacognosie. Berlin, 1873.

Hoffman, Fred., Ph. D.; Manual of chemical analysis as applied to the examination of medicinal chemicals. 8vo. 393 pp. New York, 1873.

Hahn, Edward; Die wichtigsten der bis jetzt bekannten Geheimmittel und Specialitäten, mit Angabe ihrer Zusammensetzung und ihres Werthes. 8vo. Berlin, 1874.

Planchor: Traité pratique de la détermination des drogues simples d'origin végétal. Paris, 1874.

Soubeiran, J. Léon: Nouveau Dictionnaire des falsifications et des altérations des aliments, des médicaments, etc. 8vo. 634 pp. Paris, 1874.

Springer, Julius: Ein Handbuch der Untersuchung, Prüfung und Werthbestimmung aller Handelswaaren, Natur- und Kunsterzeugnisse, Gifte, Lebensmittel, Geheimmittel, etc. 8vo. Berlin, 1874.

Hahn, E.; Die wichtigsten d. bis jetzt bekannten Geheimmittel u. Specialitäten. 3. A. 1876.

Chevallier, A., et E. Baudrimont: Dictionnaire des altérations et falsifications des substances alimentaires, médicamenteuses et commerciales, avec l'indication des moyens de les reconnaître. 8vo. 5th edition. Paris, 1877.

Hoffmann, Frederick, Ph. D.; Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals. A Guide for the Determination of their identity and quality, and for the detection of impurities and adulterations. 8vo. 393 pp. 2nd edition. New York, 1877.

Liebermann, Leo; Anleitung zu chemischen Untersuchungen auf dem Gebiete der Medicinalpolizei, Hygiene für Ärzte, Medicinalbeamte und Physikcandidaten. 8 vo. 274 pp. Stuttgart, 1877.

United States Dispensatory: Wood & Bache. 8 vo. 1879 pp. 14th ed. Phila., 1878.

Allen, Alfred H.: Commercial Organic Analysis. Vol. I. Cyanogen compounds, alcohols, and their derivatives. Phenols, acids, etc. 8vo. 360 pp. Phila., 1879.

Blyth, A. Wynter: A Manual of Practical Chemistry; the Analysis of Foods and Detection of Poisons. 8vo. 468 pp. London, 1879.

Muter, Dr. John: A key to organic Materia Medica. 8vo. 469 pp. 3d ed. 1879.

Flückiger, Friedrich A., and Hanbury, Daniel: Pharmacographia. A History of the Principal Drugs of Vegetable Origin met with in Great Britain and British India. 8vo. 803 pp. 2nd ed. London, 1879.

Squibb, Edward R.; Proper Legislation on the Adulteration of Food and Medicine. 8vo. New York, 1879.

Duflos, A.: Chemisch. Apothekerbuch. 6. Ausgabe. 1880.

Muter, John; An introduction to Pharmaceutical and Medical Chemistry. 8vo. 398 pp. Part I. Theoretical and Descriptive. 8vo. 216 pp. Part II. Analytical and Practical. Phila., 1880.

Schnacke, Dr.: Die Prüfung verfälschter, verunreinigter und imitirter Waaren nach alphabetischer Ordnung der letzteren. Ein Waaren-Wörterbuch. 8vo. Leipzig, 1880.

Bell, James: Analysis and adulteration of foods. Part I. 120 pp. 1881.

Blyth, A. Wynter: Foods; their composition and analysis. 8vo. 586 pp. London, 1882.

Pennetier, Dr. Georges: Leçons sur les Matières Premières Organiques. Paris, 1881.

Post, Dr. Jul.: Handbuch der analytischen Untersuchungen zur Beaufsichtigung des chemischen Grossbetriebes. 8vo. 528 pp. Braunschweig, 1881.

Reports on the Adulteration of Food: Supplement No. III, to the Report of the Department of Inland Revenue. Nos. I–VI. Ottawa, 1876–1881.

Dragendorff, G.: Die qualitative und quantitative Analyse von Pflanzen und Pflanzentheilen. 8vo. 288 pp. Göttingen, 1882.

Fleck, Dr. H.: Die Chemie im Dienste der öffentlichen Gesundheits pflege etc. Dresden, 1882.

Griessmayer, V.: Die Verfälschung der wichtigsten Nahrungs- und Genussmittel vom chemischen Standpunkte. 8vo. 145 pp. 2d edition. Augsburg, 1882.

Palm, R.: Die wichtigsten und gebräuchlichsten menchlichen Nahrungs-Genussmittel und Getränke. 8vo. 187 pp. St. Petersburg, 1882.

Weyl, Th.: Analytisches Hülfsbuch für die physiologisch-chemischen Uebungen der Mediciner und Pharmaceuten, in Tabellenform. 12mo. 30 pp. Berlin, 1882.

Luerssen: Medicinisch-pharmaceutische Botanik. Leipzig (in progress).

THE BIBLIOGRAPHY AND LITERATURE OF FOOD AND DRUGS AND THEIR ADULTERATION.

The analysts employed by the State Board of Health, and all other persons concerned in preventing adulteration and harm of food and articles used as medicine must have as complete information as possible concerning the results of scientific investigation of these matters. As no complete lists of these important volumes, journals and contributions existed in suitable forms for common reference by analysts and inspectors, it has been a laborious duty of the Sanitary Committee and the experts who have been engaged in this branch of the Board's work, to prepare adequate lists of the literature examined by them and found available for useful reference. These bibliographical lists are printed in connection with the several reports of the anyalsts for the benefit of all sanitary authorities.

E. H. *Secretary.*

INDEX.

PAGE.

☞ For Index of Chemical Part see next pages.

INDEX OF REPORTS UNDER CHAPTER 407 OF THE LAWS OF 1881,

For Preventing Adulteration of Food and Drugs
